

DOCUMENT RESUME

ED 331 214

EC 300 195

AUTHOR Bullis, Michael, Ed.; Fielding, Glen, Ed.
 TITLE Communication Development in Young Children with Deaf-Blindness: Literature Review.
 INSTITUTION Oregon State System of Higher Education, Monmouth. Teaching Research Div.
 SPONS AGENCY Office of Special Education and Rehabilitative Services (ED), Washington, DC.
 PUB DATE 88
 CONTRACT 300-83-0237
 NOTE 266p.; For related documents, see EC 300 196-197.
 PUB TYPE Information Analyses (070) -- Collected Works - General (020)

EDRS PRICE MF01/PC11 Plus Postage.
 DESCRIPTORS Auditory Tests; Child Language; Communication Aids (for Disabled); Communication Skills; Contingency Management; *Deaf Blind; Evaluation Methods; Interaction; *Intervention; *Language Acquisition; Mothers; Multiple Disabilities; Operant Conditioning; Oral Language; Parent Child Relationship; Play; Preschool Education; Skill Development; Tactile Stimuli; Tactual Perception; Vision Tests; Young Children

IDENTIFIERS Augmentative Communication Systems; Preverbal Communication

ABSTRACT

This review summarizes and discusses literature relevant to the communication development of young children (0-5 years) with deaf-blindness. The review is divided into topical areas. The topical areas and the contributors for each area are as follows: "Perspectives on Communication Assessment" (Charity Rowland); "Research in Tactile Communication" (Cynthia Jones and others); "Visual Assessment" (Pamela J. Cress); "Hearing Evaluation of Infants and Children at Risk for Severe Hearing and Vision Deficiencies" (John Brandt and Joseph E. Spradlin); "Nonsymbolic Communication in Early Interactional Processes and Implications for Intervention" (Ellin Siegel-Causey and others); "Mother-Child Interaction and the Development of Preverbal Communication" (Madeline W. Appell); "The Play of Young Children Who Have Dual Sensory Impairments" (David M. Finn and others); "Development of Emergent Language" (Kathleen Stremel-Campbell and Jimmie Matthews); "Contingency Intervention" (Philip Schweigert); and "Augmentative Communication Systems" (Pamela Mathy-Laikko and others). References accompany each paper. (JDD)

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COMMUNICATION DEVELOPMENT

IN YOUNG CHILDREN WITH

DEAF-BLINDNESS: LITERATURE REVIEW

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COMMUNICATION DEVELOPMENT IN YOUNG CHILDREN
WITH DEAF-BLINDNESS: LITERATURE REVIEW

Edited by
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1988

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This manuscript was provided under contract #300-83-0237 from the Office of Special Education and Rehabilitative Services, United States Department of Education. The information presented herein does not necessarily reflect the policy of that office and no official endorsement should be inferred.

PREFACE

Perhaps no handicapping condition is as debilitating as the dual sensory impairment of deaf-blindness. All too often, young children with this type of condition have difficulty developing even rudimentary communication skills. This situation is further exacerbated by a relative absence of systematic research, assessment tools, and curricula expressly designed for persons with deaf-blindness. Fortunately, in recent years, the professional community has directed more attention to this population, and various research endeavors have been initiated to develop appropriate and useful materials.

One such effort was the Communication Skills Center for Young Children with Deaf-Blindness (CSC). This project was funded through a 5-year contract that was awarded in 1983 to the Teaching Research Division of the Oregon State System of Higher Education by the United States Office of Special Education and Rehabilitation. The overall goals of CSC were to develop, implement, evaluate, and disseminate communication interventions to increase the early communication and language competencies of young children (0-5 years) with deaf-blindness. Toward this end a multisite, consortium model was adopted. The CSC was administered through the Teaching Research Division and included as members the Portland, Oregon, Public Schools; University of Kansas, Department of Special Education; Parsons State Hospital and Training Center, Parsons, Kansas; University of Washington, Experimental Education Unit; University of Wisconsin-Madison, Waisman Center; St. Luke's Hospital, New York; and Utah State University, Exceptional Child Center. At each of these sites specific topics related to communication development in children with deaf-blindness were investigated.

This manuscript is only one of the products generated through the CSC. Its intent is to summarize and discuss literature that is relevant to the communication development of the target population. It is our hope that the document will be both interesting and helpful to the reader; and that, in some way, it will aid children with deaf-blindness.

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TABLE OF CONTENTS

	Page
I. Perspectives on Communication Assessment Charity Rowland	1
II. Research in Tactile Communication Cynthia Jones, Charles R. Spellman and Paul V. Ozier	23
III. Visual Assessment Pamela J. Cress	37
IV. Hearing Evaluation of Infants and Children at Risk for Severe Hearing and Vision Deficiencies John Brandt and Joseph E. Spradlin	51
V. Nonsymbolic Communication in Early Interactional Processes and Implications for Intervention Ellin Siegel-Causey, Barbara Ernst, and Douglas Guess	69
VI. Mother-Child Interaction and the Development of Preverbal Communication Madeline W. Appell	123
VII. The Play of Young Children Who Have Dual Sensory Impairments David M. Finn, Rebecca R. Fewell, and Patricia F. Vadasy	149
VIII. Development of Emergent Language Kathleen Stremel-Campbell and Jimmie Matthews	165
IX. Contingency Intervention Philip Schweigert	203
X. Augmentative Communication Systems Pamela Mathy-Laikko, Ann E. Rateliff, Francisco Villarreal, and David E. Yoder	225

L Perspectives on Communication Assessment

by

Charity M. Rowland

Assessing sensory, communicative, social, and cognitive functioning is extremely difficult in children with vision and hearing impairments. This difficulty is due to motivational problems, limited response repertoires, or the absence of language. Many of the traditional assessment instruments rely upon the subject's ability to comprehend and cooperate with verbal instructions. They also generally rely on verbal responses. This dependence upon receptive and expressive language ability renders such tests useless with nonverbal individuals and has resulted in labelling many children with deaf-blindness as "untestable."

Until recently, vision and hearing assessments for children with severe disabilities were limited to physiological and electrophysiological techniques that assess only the gross intactness and pathology of the sensory systems. Even these techniques may be inappropriate, however, if the subject demonstrates a lack of cooperativeness or severe seizure disorders. Subjective behavioral techniques requiring nonverbal responses, some of which utilize operant or classical conditioning procedures, have been developed; however, many of these tests require the comprehension of verbal instructions, extensive pretraining, or the production of specific fine motor responses. Vision and hearing assessments that provide educationally useful data for young deaf-blind children are only currently being developed. (For a complete discussion of assessment in these areas see the chapters by Cress and Spradlin in this volume.)

In the domains of cognitive, communicative, and social development, the standard assessment tools are weighted heavily on the verbal factor and have not been useful for children with both vision and hearing impairments. Until a decade ago, the lowest level of sociocommunicative development was widely considered to be the absence of language. Children with disabilities were labelled either "verbal" or "nonverbal." The verbal label encompassed a wide range of linguistic skill levels, and the nonverbal label simply indicated a total lack of communicative ability. Presently, communication is viewed as a continuum including a wide spectrum of preverbal behaviors and nonspeech language skills, as well as conventional language. This acknowledgement of the communicative import of nonverbal behaviors has had a positive impact upon the assessment of persons with severe disabilities. In the highly interrelated cognitive and sociocommunicative domains, it is now possible to examine the development of generic skills that are demonstrated through either nonverbal or verbal means.

Some global assessment instruments exist that may be used to evaluate overall development in the target population. In Table I-1, nine of the most commonly used of these instruments are listed, along with comments on six important test characteristics, such as age range, score referencing, target population, adaptations for individuals with deaf-blindness, scoring system, and reliability/validity data. These instruments vary widely in their applicability and usefulness with the target population. Only one, the Callier-Azusa Scale (Stillman, 1978) was developed specifically for use with individuals with dual sensory impairments.

Simeonsson, Huntington, and Parse (1980) list many problems related to the assessment of young children with severe and profound handicaps. They conclude that "the problems of the child are interdependent with those associated with the assessment

Table 1. Global Assessment Instruments Used with Deaf-Blind Children

Assessment Instrument & Subscales	Age Range	Score Referencing	Target Population	Adapted for Deaf-Blind	Scoring System	Reliability/Validity Provided
AAMD Adaptive Behavior Scale, Part One (Mihira, Foster, Shellhaus & Leland, 1974) (Independent Functioning, Physical Development, Economic Activity, Language Development, Numbers & Time, Domestic Activity, Vocational Activity, Self-Direction, Responsibility, Socialization)	3 yrs. +	Normed on population with mental retardation & population with deaf-blindness	Individuals with mental retardation	Yes	Score	Yes
Adaptive Performance Instrument (Consortium on Adaptive Performance Evaluation, 1978) (Gross Motor, Fine Motor, Self Care, Interaction with Objects, Interaction with Adult & Peers, Understanding Communication, Using Communication)	0-2 yrs.	Criterion-referenced	Children with severe handicaps	Yes	Score & Profile	Yes
Bayley Scales of Infant Development (Bayley, 1969) (Mental, Motor, Infant Behavior Record)	2-30 mo.	Normed on nondisabled population	Nondisabled infants	No	Score	Yes
Behavior Rating Instrument for Autistic and Other Atypical Children (Ruttenberg et al., 1977) (Relationship, Communication, Sound/Speech Reception, Vocalization/Expressive Speech, Drive for Mastery, Social Responsiveness, Body Movement, Psychobiological Development, Receptive Gestural/Sign Language, Expressive Gestural/Sign Language)	0-4 yrs.	Criterion-referenced. Normed on autistic population	Children with autism	Yes*	Score & Profile	Yes
Callier-Acusa Scale (Stillman, 1978) (Motor, Perceptual, Daily Living, Cognition/Communication/Language, Social)	0-84 mo.	Criterion-referenced	Deaf-Blind	Yes	Profile	No
Early Intervention Developmental Profile (Schafer & Hoersch, 1981) (Perceptual/Fine Motor, Cognition, Language, Language, Social/Emotional, Self Care, Gross Motor)	0-3 yrs.	Criterion-referenced	Children with variety of handicaps	No	Profile	Yes

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Table 1. Global Assessment Instruments Used with Deaf-Blind Children, continued

Assessment Instrument & Subscales	Age Range	Score Referencing	Target Population	Adapted for Deaf-Blind	Scoring System	Reliability/Validity Provided
McCarthy Scales of Children's Abilities (McCarthy, 1972) (Verbal, Perceptual-Performance, Quantitative, Memory, Motor, General Cognitive)	2.5-8.5 yr.	Normed on nondisabled population	Nondisabled children	No	Score	Yes
Portage Guide to Early Education, Revised Edition (Bluma, et al., 1978) (Cognitive, Self-Help, Motor, Language & Socialization, Infant Stimulation)	0-6 yrs.	Criterion-referenced	Children with developmental disabilities	No	Profile	No
Wisconsin Behavior Rating Scale (Song, et al., 1980) (Gross Motor, Fine Motor, Expressive Language, Receptive Language, Play, Socialization, Domestic Activity, Eating, Toileting, Dressing, Grooming)	0-3 yrs.	Criterion-referenced. Normed on population with severe handicaps	Children with severe handicaps	Yes	Score & Profile	Yes

*Adapted version developed by: Deaf-Blind Communication Activities Project (CAP)
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process" (p. 53). In fact, the development of useful and psychometrically sound measurement tools is one of the most pressing challenges facing professionals who work with children with dual sensory impairments. The purpose of this manuscript is to address the general problems of assessing children with vision and hearing impairments, and those of assessing communication-related skills in particular. The paper begins with a discussion of test referencing and the difficulties of using available norm- and criterion-referenced tests with the target population. Next, specific difficulties associated with the assessment of communication are discussed. Finally, available communication assessments appropriate for use with individuals who have dual sensory impairments are reviewed.

General Assessment Issues

Carver (1974) describes the two dimensions along which tests are constructed as "psychometric" and "edumetric." Psychometric tests, such as the standard school aptitude and achievement tests, are designed to reflect stable differences between individuals. This purpose is best served by selecting test items that are moderately difficult and demonstrate high variability between subjects. For instance, an item that is passed by 50% of the individuals who take the test (i.e., with a probability of .50) is the ideal item to use to distinguish between the performance of two individuals. In general, psychometric tests are best suited for the purposes of screening, educational placement, and program evaluation.

Edumetric tests, on the other hand, such as the Brigance Diagnostic Inventory of Basic Skills (Brigance, 1976), are designed to be maximally sensitive to progressive change within an individual on successive administrations. The ideal item for an edumetric test is one that is passed with a probability of .00 on a pretreatment administration and with a probability of 1.00 on a posttreatment administration. Edumetric tests are best suited for the purposes of instructional planning and pupil evaluation.

Another facet of test construction is test referencing. Test scores must be referenced relative to some organized set of standards such as age norms, an ordinal sequence of educational objectives, or sequenced samples of broad skill domains. The psychometric/edumetric dichotomy translates directly into the two major methods of test referencing described below.

Test Referencing

Donlan (1975) identifies no fewer than eight types of test referencing. The major break in this listing is between the norm-referenced test (NRT) and the criterion-referenced test (CRT). As Swezey (1981) explains, norm and criterion referencing are methods of interpreting test scores. The nine types of test referencing listed by Donlan (1975) include norm referencing plus what amount to eight variations on criterion referencing. These variations on the CRT are distinguishable by test content, rather than by the method of score interpretation. The major characteristics of NRTs and CRTs are outlined below.

The NRT is empirically constructed based upon the psychometric properties of a large pool of test items. Test items are selected based upon their ability to differentiate between the performance of individuals belonging to a clearly specified group. Each item is referenced, or normed, according to the relative age or grade level of subjects who typically pass or fail the item. Since the percentage of persons who pass each item at a given age or grade level is provided, the results provide information on the

performance of an individual relative to others of the same age or grade. NRTs tend to be loaded along Carver's psychometric dimension and are generally most appropriate for purposes of screening, educational placement, and program evaluation.

Criterion-referenced instruments have proliferated in the past 20 years in response to a need for information that can be translated directly into intervention strategies. In special education, the need emerges from the fact that many tests normed on a population without disabilities are inappropriate for children with severe disabilities. In many instances, children with severe impairments have been labelled untestable because the available NRTs could not be administered to them. Consequently, many CRTs have been developed for use with low-incidence populations with specific disabilities. Typically, these tests are not normed on large pools of subjects, nor are they subjected to rigorous statistical evaluations.

In a CRT, each item is related more or less directly to a performance objective (generally a behavioral objective) and scores are assumed to have absolute meaning, regardless of the performance of other test-takers. Items are arranged conceptually according to some logical order--most often the developmental sequence demonstrated by students without disabilities, or the sequence of a particular curriculum to which the assessment is linked. Usually, CRT items are scored pass/fail. The inability to meet the passing criterion for a given item implies a skill deficit and an appropriate area for training. In some cases a given item may represent a skill that is in itself a targetable objective (e.g., "scoops food from spoon with upper lip"). Alternatively, items may represent specific behaviors that indirectly reflect more fundamental, generic skills (e.g., "pulls string to obtain object that is out of reach"; implying comprehension of a specific means-ends relationship). In other tests, items may be expressed generically, so that any number of specific behaviors might serve to illustrate mastery (e.g., "attracts attention to self before communicating"). Criterion-referenced tests are highly related to Carver's edumetric dimension and are used most often (though not exclusively) for instructional planning and pupil evaluation.

NRTs and CRTs also tend to differ in terms of measurement techniques. Whereas the typical NRT relies upon professionally administered performance items using standardized materials, the CRT is more likely to involve a variety of data sources. A CRT, such as the Callier-Azusa Scale (Stillman, 1978), may be completed using a synthesis of observational data, teacher reports, parental reports, and performance data from structured tasks. The more difficult a subject is to assess, the more important it becomes to allow for flexible measurement techniques such as naturalistic observations and parental reports. (See Hansen, 1980, for a thorough discussion of measurement techniques used in special education.)

It should be noted that norm and criterion referencing need not be mutually exclusive test properties. A few available assessments incorporate both types of referencing. For example, the Sequenced Inventory of Communication Development (Hedrick & Tobin, 1975) is a CRT that has been normed on a population without disabilities so that functional age equivalence scores may be obtained. The Wisconsin Behavior Rating Scale (Song et al., 1980) is an example of an assessment normed on both a population with severe impairments and a population without disabilities.

The provision of norms from the specific target population is becoming more common in test development for populations with disabilities. However, the administration of traditional NRTs and CRTs to children with deaf-blindness still presents a number of specific difficulties. These difficulties are discussed below.

Problems with Norm-referenced Assessments of Global Development

Difficulties in the use of norm-referenced assessments revolve around the fact that most NRTs are based upon the development of children without disabilities. These children become responsive to language and social reinforcement early in life, are usually highly motivated to perform, and have wide response repertoires. It is no wonder that measures constructed exclusively from the performance data of such groups yield little useful information about a child with severe disabilities. Several specific problems associated with the use of NRTs for children with multiple impairments are presented below.

Age appropriateness. Some children with deaf-blindness function developmentally on an infantile level, despite a higher level of physical maturity. The age appropriateness of test items becomes an issue when, as with the target population, great disparity exists between a child's chronological age and his or her overall level of functioning. At least two problems arise when tests developed for infants or young children are used to assess older children and adults. First, the materials that are appropriate for infants and young children are generally inappropriate for older subjects and may make the testing situation un motivating to the older subject. For example, an older child may not show the enthusiasm for a smiling face or the fascination with a mirror image that one expects from an infant; or an older child may not be motivated to manipulate the blocks, beads, and dolls that evoke curiosity in an infant without disabilities. Second, test items developed for infants assume an infantile level of motor functioning. Many items found in cognitive or communicative subscales that are appropriate for preambulatory infants become singularly inappropriate when administered to an ambulatory child or a large, physically robust person. For instance, a person should not be expected to reach toward a desired object as a means of requesting it if he or she can stand up, walk over, and obtain it independently. Thus, the items and testing materials included in a specific NRT may be inappropriate for use with subjects who differ significantly in age from the normed population.

Adaptations. Considerable disparity between competence and performance is often encountered in testing children with severe disabilities. The correct administration of items from standardized tests often fails to elicit the desired behavior, even though that behavior might be observable under slightly different circumstances. Individual children may respond to different stimuli, heavy reinforcement, social motivation, longer stimulus presentations, or longer response time, depending upon their motor, sensory, social, or cognitive functioning. To overcome the problems of administering NRTs to children with disabilities it is tempting to rely upon "adaptations" of test items. These adaptations may involve different stimulus materials, methods of stimulus presentation, performance criteria, or response modes. Such adaptations, however, defeat the purpose of the NRT, which is to compare the performance of individuals under very carefully documented, standardized conditions. Any departure from the original testing procedure alters the results in unknown ways and invalidates the calculation of age- or grade-equivalence scores.

Lack of sensitivity. Swanson (1979) describes the difficulties in using specific subscales from NRTs, such as the Bayley Scales of Infant Development (Bayley, 1969) or the McCarthy Scales of Children's Abilities (McCarthy, 1972), with children who have severe disabilities. Essentially, these types of scales are constructed to present a broad overview of development across a number of domains such as fine and gross motor skills, cognition, perception, and language. The number of items per subscale is likely to be relatively few, providing insufficient sensitivity to distinguish among children who develop relatively slowly. Therefore, these scales are not likely to provide the

in-depth information that is required by a professional to construct specific interventions in any one particular area of a child's development. This sensitivity problem is inherent in a psychometrically constructed test. Only items that represent rather large developmental increments are likely to distinguish reliably between age levels, since the age at acquisition of developmental milestones is highly variable even in children without disabilities. A related issue is the consistency of item sensitivity across an entire scale. Psychometrically devised assessments are generally less sound at the high and low ends, or margins, of a given scale. It is precisely at the margins of a scale that individuals with handicaps are likely to perform (Ysseldyke & Shinn, 1981). Thus, the inherent inconsistency of a scale's sensitivity is more likely to affect the scores of individuals with handicaps than those of individuals without such impairments.

Confounding of skill areas. In many NRTs, certain skill areas tend to be confounded between subscales. That is, items from any given subscale are likely to tap skills from other developmental areas. For instance, a cognitively based item may involve a response requiring a certain level of motor functioning and visual acuity, or a social item may require a formal language response. In children whose development proceeds across domains at a fairly steady pace such multiskill requirements do not present a problem, but for the child with severe sensory or motor impairments, the assessment problem becomes quite serious. A child may fail many items on a subscale simply because he or she is incapable of responding in the required mode. As an example, in the first half of the mental subscale of the Bayley Scales of Infant Development, 36% of the items require intact vision. Thus, a child with a visual impairment would be expected to score poorly on this scale, regardless of actual cognitive ability. Unfortunately, some of this interaction between subscales is unavoidable. Cognition, cannot, in fact, be assessed without tapping motor, social, and communicative skills (Darby, 1979). The high degree of confounding of skill areas found in many NRTs leads to attempts to adapt test stimuli or response modes to accommodate the child's sensory or motor deficits. The dangers of using unvalidated adaptations of test items were noted earlier in this chapter.

Problems with Criterion-Referenced Global Assessments

In response to difficulties and frustrations with the use of NRTs in special education, a plethora of CRTs have appeared in the past 10 to 15 years. These tests have the advantage of being constructed to meet the assessment needs of populations with specific disabilities. They are designed specifically to circumvent the problems of administration and the lack of utility that are associated with NRTs. However, they are not a panacea. As Rutberg (1980) notes, few such instruments are standardized, many are procedurally weak or imprecise, many do not provide clear scoring procedures, and reliability and validity data are unavailable for most. These problems are discussed below.

Procedural weaknesses. Many CRTs consist of checklists of pertinent behaviors that are scored as present or absent. Test stimuli and the range of acceptable responses are seldom specified, and procedures may not be provided for testing those items that do not occur spontaneously. Further, criteria for mastery of individual items are often omitted. For example, the following kinds of procedural questions are encountered: Should a given behavior be observed once a year, twice a week, or five times a day before mastery is inferred? How many times should a three-item matching task be administered and what percentage of correct responses is required for mastery? Without clear procedures and specific scoring criteria, the validity of CRTs is seriously impaired. Such shortcomings may result in data that are inaccurate and educationally misleading.

Lack of reliability and validity data. Validity refers to the degree to which a test measures what it claims to measure. Three types of validity are generally addressed

according to the Standards for Educational and Psychological Tests, published by the American Psychological Association (1974): content validity (the adequacy with which the test samples the content area tested); construct validity (the degree to which the explanatory constructs of an underlying theory are related to the test results); and criterion-related validity (the relationship between the tests and other independent measures of criterion behavior taken concurrently [concurrent validity] or at a later date [predictive validity]).

Reliability refers to the consistency of results obtained from multiple administrations of the test or the administration of multiple forms of the test. According to the Standards for Educational and Psychological Tests, the three traditional types of reliability that can be computed are coefficients of stability (correlation of scores from successive administrations of the same test); coefficients of equivalence (correlation of scores from administration of alternate test forms); and coefficients of internal consistency (correlation of items within the test to total test score). Another type of reliability that is highly relevant to CRTs is interobserver reliability. Most CRTs in special education are scored according to highly subjective judgments and observations of teachers, parents, and therapists. If these tests are readministered by different personnel, discrepant scores may reflect a lack of interobserver reliability rather than a change in the subject.

Reliability and validity are generally considered to be the cornerstones of assessment. Thus, it is surprising that few infant assessment measures include reliability or validity information. Some authors (Popham & Husek; cited in Shaycoft, 1979) have suggested that the computation of reliability and validity is not only irrelevant, but detrimental to the use of CRTs. This argument is based largely on the fact that traditional reliability coefficients (i.e., stability, equivalence, internal consistency) often cannot be computed for CRTs. Shaycoft (1979), however, dispels this argument. He suggests two alternative methods for computing reliability for CRTs. In the first alternative, time elapsed is the dependent variable, and percentage of mastery is the independent variable. In the second alternative, the raw score is the dependent variable, and time of testing is the independent variable. In summary, it is possible to compute reliability and validity measures for CRTs, and these computations should be an integral component of test development.

Lack of scoring standards. Some CRTs provide no method of deriving a score from test performance, and others yield only a visual profile. Obviously, such shortcomings severely limit the usefulness of the test results for evaluation purposes. It is certainly more difficult to establish a scoring system for the CRT than for the NRT. In the NRT, items can be roughly equally spaced and weighted according to their psychometric properties, thus facilitating score computation. In the CRT, however, the conceptual distance between items is somewhat arbitrary and their ordinality may not be meaningful. Still, a logical scoring system should be possible if the test's construction is based upon a well-developed theoretical perspective. Several tests based upon Piagetian theory (e.g., Dunst, 1980; Seibert & Hogan, 1981), for instance, have scoring systems that allow the placement of a subject at a specific level of cognitive or communicative development. For a more complete discussion of guidelines for the construction and scoring of CRTs see Swezey (1981).

Ordinality and educational implications. Perhaps the most serious issue for CRTs rests in the rationale or conceptual premise underlying the sequencing of items in such measures. Some CRTs, such as the Uzgir-Hunt Scales (1975), are based upon a clearly specified theoretical position. The ordinality of this particular scale is dictated by a

clear logic proceeding directly from Piagetian theory. Other instruments lack a clearly stated conceptual approach to explain their organization.

In many of the better known CRTs, items are selected from a wide range of norm-referenced instruments and then arranged according to the age equivalencies taken from the source instruments. When items from different tests are combined in this manner, their ordinality (even in the originally normed populations) becomes highly questionable. The use of such developmental scales in special education has been challenged by several authors (Garwood, 1982; Switzky, Rotatari, Miller, & Freagon, 1979). Garwood discusses the fact that when items are sequenced according to psychometric norms, the conclusion is often made that the sequence is logical, necessary, and invariant. An apparent temporal relationship between two behaviors, though, does not imply a structural relationship between them. In fact, several different developmental processes may underlie the appearance and disappearance of specific skills. The issue of ordinality becomes problematic when assessment data are tied closely to instructional consequences. If a child fails an item from a CRT, that item is often assumed to constitute an appropriate instructional objective. If the item does not represent either a functional and age-appropriate behavior in and of itself or a demonstrated prerequisite to other functional behaviors, such a conclusion is not warranted. Unfortunately, the theoretical foundation of many CRTs is too tenuous to support an isomorphic relationship between assessment items and instructional objectives.

Assessment of Communication

Communication presents some unique assessment problems. First, communication skills are so intricately related to cognitive and social skills that they cannot be assessed without tapping these other developmental skill areas. In the simplest terms, cognitive development dictates the content of communication. If a child cannot make sense of his or her environment, then that child cannot generate communicative content to share with another person. Social development, on the other hand, provides the motivation to communicate. If a child lacks either attachment to other persons or awareness of their roles as social agents, then that child has no reason to communicate with another person. To complicate matters further, motor skills are also implicated to the extent that an expressive mode must be available for communication to occur. In some cases, a child may have the cognitive and social skills necessary to communicate, but may not have a motoric means of expression.

Twenty years ago, language was virtually the only recognized form of communication, and language assessments accommodated only the spoken form of language. It is only fairly recently that we have realized that communication begins before formal language appears and that language does not have to be realized through speech. Research efforts of the Communication Skills Center for Young Children with Deaf-Blindness (CSC) are based upon a body of literature suggesting that preverbal communicative behaviors are essential precursors of linguistic behavior (see the chapters by Siegel-Causey, Ernst, and Guess, and Stremel-Campbell and Matthews in this volume). Since most of the children studied by the CSC do not possess a formal language system, these preverbal communication systems must be addressed accurately by a communication assessment. In the following subsections some of the important issues related to the assessment of communication skills in individuals with deaf-blindness are discussed.

Modes of Communication

A scale that is appropriate for use with young children with sensory and motor impairments must allow for nontraditional modes of comprehension and production. The

scale must be flexible enough to accommodate the use of very limited physical responses (e.g., eye blinks, head turns) or artificial communication systems (e.g., objects, pictures, electronic devices) as expressive and receptive communication modes. In addition, the scale must allow for multiple response modes for the subject who uses more than one mode of communication (e.g., pictures and manual signs). Finally, the instrument must accommodate divergent receptive and expressive communication modes, since a child with sensory impairments may use different modes for comprehension and production. Otos (1983) has developed a protocol (reviewed later in this chapter) for analyzing the use of three modes of expressive communication: tactile communication, objects, and manual gestures and signs.

The Pragmatic Aspects of Communication

Beyond assessing the presence or absence of specific communicative behaviors, and the content (semantics) and form (syntax) of linguistic structures, a communication assessment should also address the social implication of communicative behaviors. To this end, a thorough assessment must track the pragmatic function, or intent, of communication (e.g., requests, protests, greetings). Function is the effect that communication actually has upon the social environment, and intent is the effect that the communicator intends to have upon the social environment. Function is amenable to operational definition. Intent, although it tells us more about the communicator, can only be inferred from the total communicative context. Needless to say, function and intent are not always congruent, especially when the communicator has very limited means of communication. Pragmatic analyses of function and intent were originally restricted to speech acts (Dore, 1975; Halliday, 1975), but have been extended to the analysis of preverbal communication in children without disabilities by Bates, Camaioni, and Volterra (1975), Coggins and Carpenter (1981), and in youth with severe handicaps by Cirrin and Rowland (1985).

Chapman (1981) points out that the effectiveness of children's communication is another important aspect of assessment. The effectiveness of communication is largely influenced by the dyadic interaction (or discourse) skills of the child—skills such as establishing, returning and maintaining eye contact with a speaker; waiting one's turn while another speaks and then filling in the silence; or attracting the listener's attention prior to speaking. Of the various aspects of communication, dyadic interaction has received the least attention in communication assessments to date. Both Seibert and Hogan (1981) and McLean, Snyder-McLean, Rowland, Jacobs, and Sack (1981) directly address dyadic skills in instruments reviewed later in this chapter.

Sensitivity

A high degree of sensitivity is essential in a communication assessment for deaf-blind children for two reasons. First, the items must represent modest increments in skill development in order to track progress in individuals who demonstrate small or subtle changes over extended periods of time. Second, only a highly sensitive scale has the potential to elucidate the developmental sequences within and between social, cognitive, and communicative domains. One of the opportunities provided by the assessment of a population with specific handicaps is the potential for contributing to our knowledge of basic developmental sequences in both disabled and nondisabled populations. In the words of Simeonsson, et al. (1980), "The absence of a natural history of the development of handicapped children has restricted the ability to predict outcome and to make comparisons among and between children with similar and different handicapping conditions" (p. 67). Longitudinal research on skill acquisition by children with specific sensory impairments will aid in sorting out the relationships between

sensory, cognitive, communicative, and social development in children with and without disabilities. Such research may clarify the status of a specific skill, such as pointing, as a prerequisite or precursor to a later developing skill, such as verbal labelling.

Campbell and Ritchie (1983) discuss the inadequacy of empirical techniques in developmental research for determining developmental sequences of behaviors. They clearly distinguish between developmental prerequisites versus developmental precursors and discuss the importance of identifying both. Jamison and Dansky (1979) present a data-analytic procedure for identifying developmental prerequisites that depends upon a high degree of sensitivity in both item selection and item scoring. Cole, Swisher, Thompson, and Fewell (1985) have developed a generic 16-point scale that might be used to score many developmental items. This system provides for scores of 0 to 3 in four categories: frequency of response, generalization of response, initiation of behavior, and fluency of response. A sensitive scoring system such as this one, along with sensitive item selection, would increase the likelihood that a communication assessment would contribute to a theoretical rationale for communication development as well as provide sensitive tracking of student progress.

Theoretical Foundation for Assessment

One of the most serious criticisms of CRTs is that many are not tied to a well-developed theoretical foundation, a criterion identified by Simeonsson and others (1980) as essential to the development of a coherent framework for the assessment of individuals with severe handicaps. Although a psychometrically constructed measure need not be based on theory, a CRT should reflect a theoretical foundation in its organization. Many assessments are organized according to the developmental sequence of individual items from a range of norm-referenced instruments. Mere developmental ordinality, however, does not represent any specific theory of development. A number of theory-based instruments reflect Piagetian or neo-Piagetian theory of cognitive development (e.g., Seibert & Hogan, 1981). Theories of social development might also form a structural basis for a communication assessment. Without a coherent theoretical foundation to guide item selection, ordinality, scoring, and use, the educational implications of an assessment instrument are severely limited.

Generic Items

The need to accommodate different modes of stimulus input and response and the varying sensory and motor abilities of subjects has been discussed. These complications make the use of specific stimulus and response requirements problematic. A child may have mastered the underlying ability reflected in a traditional assessment item but may be unable to perform the required specific response. To circumvent this problem, some authors (McLean, et al., 1981; Consortium on Adaptive Performance Evaluation, 1978) have used generic assessment items that describe a fundamental skill, rather than specific behaviors. For instance, rather than "Waves to another person who enters visual field and speaks to child," a generic item might read "Greets person who enters child's perceptual field." Examples of appropriate responses may accompany each generic item so that the examiner knows what sorts of specific behaviors reflect mastery of the generic item. One drawback to a generic skill inventory is that the number of test items may be fairly small. However, a sensitive scoring system could be combined with generic assessment items to provide a wider range of potential scores and a more precise index of development.

Test Administration: The Process Approach

The method by which an assessment instrument is administered is as important as its construction. The manner in which an assessor administers a test reflects, consciously

or not, an underlying philosophy of assessment as well as a philosophy of communication development. If one views communication development as a transactional process (McLean & Snyder-McLean, 1978), then that process involves reciprocal causation between the child and the environment, as reflected in the developmental models proposed by Sameroff (1975) and Vygotsky (1978). Consequently, the assessment of the child alone, or of the environment alone, is not likely to yield useful information (Ulvund, 1984). A number of authors (Fewell, 1984; Meyers, Pfeiffer, & Erlbaum, 1985; Simeonsson, et al., 1980) have proposed a "process" approach to assessment that lends itself particularly well to the assessment of communication. In essence, the process approach involves measurement of the child, the environment, and the interaction between the two. The assessor becomes an active participant in the assessment and thus an element of the environment that is subject to measurement, actively tailoring the assessment to the child's needs. Generic test items are particularly appropriate for process-oriented assessment since they are flexible in terms of materials, tasks, and settings (Simeonsson, et al., 1980). The goal of the process approach is to discover the child's abilities rather than to document failure. The assessor often uses test-teach-test tasks (Fewell, 1984) to find out how, when, and where a child's optimal performance occurs, with the assumption that the child can learn (Meyer et al., 1985).

The process approach helps to minimize the disparity between competence and performance that is frequently encountered in the target population. A child with severe sensory impairments may not perform on a level commensurate with actual ability in a free-field observational setting or in the presence of unfamiliar examiners administering rigid, material-specific tasks. Chapman (1981) advocates structuring the communication testing situation to produce "obligatory contexts" for communication by arranging standard situations to elicit the behaviors of interest. Cirrin and Rowland (1985) have constructed such a protocol for use with nonverbal persons with severe retardation. This protocol represents a standard set of loosely structured routines designed to elicit communicative behavior. As an example, in one routine the observer offers the subject a highly reinforcing item in a translucent container that the subject is unable to open. The subject is forced to request the observer's help to obtain the item. Structured formats such as these allow a dynamic assessment process within the constraints of a procedure that may be scored objectively.

Instruments Currently Available

In the past few years, a number of communication assessments have appeared that incorporate the most current perspectives on language development and that include a range of preverbal communication items. Some of these have been designed specifically for, or have been adapted for use with, persons who have severe disabilities or deaf-blindness. The most current and pertinent of these instruments are presented in Table I-2. For each instrument, the following characteristics are summarized: target populations, adaptations for individuals with deaf-blindness, scoring system, and number of items. It is important to note that most of these instruments are recently developed CRTs (some are only available in experimental editions), and only three of them (Barnard, 1978a, 1978b; Connard, 1984; Meyer et al., 1985) provide reliability and validity data. The instruments cited in Table I-2 are reviewed briefly below.

Assessment of Social Competence

The Assessment of Social Competence, or ASC (Meyer et al., 1985), is not, strictly speaking, a communication assessment. It measures "social competence functions" necessary for social interaction across natural environments. The instrument is divided into 11 subscales representing social competence functions such as Initiate, Indicate

Table 1-2. Preverbal Communication Assessment Instruments

Assessment Instrument & Subscales	Target Population	Deaf-Blind Adaptations	Scoring System	Number of Items
Assessment of Social Competence (ASC)				
(Meyer et al., 1985) (Initiate, Self-Regulate, Follow Rules, Provide Positive Feedback, Provide Negative Feedback, Obtain Cues, Offer Assistance, Indicate Preference, Cope with Negatives, Terminate)	All age ranges and handicapping conditions (0-adult skill levels)	Open-ended, generic items suitable for persons with deaf-blindness	Score (Level of competence for each subscale)	254
Callier-Azusa Scale-H				
(Stillman & Battle, 1986a) (Representational & Symbolic Development, Receptive Communication, Intentional Communication, Reciprocity)	Individuals with deaf blindness or severe & profound handicaps (0-24 month skill levels)	Yes	Profile	93
Communication Placement Assessment				
(Stremel-Campbell, 1984) (Responses to Sensory/Social Input, Interaction with Objects Vocal Development, Receptive, Communication, Expressive Communication)	Children with severe handicaps (0-24 month skill levels)	No	Profile	144
Communication Programming Inventory				
(Sternberg & Adams, 1982) (Cognition, Receptive Communication, Expressive Communication)	Individuals with severe and profound handicaps (0-24 month skill levels)	No	Score (Level of functioning for each subscale)	162
Early Social Communication Scales*				
(Seibert & Hogan, 1981) (Responding to Social Overtures, Initiating Social Interaction, Maintaining Sustained Social Interaction)	Children with developmental disabilities (10-24 month skill levels)	No	Score (Communication level)	112

Table I-2. Preverbal Communication Assessment Instruments (continued)

Assessment Instrument & Subscales	Target Population	Deaf-Blind Adaptations	Scoring System	Number of Items
Generic Skills Assessment Inventory (GSAI)				
(McLean, et al, 1981) (Object Relationships, Representation, Dyadic Interaction, Expressive Communication, Comprehension/ Imitation)	Nonverbal youth with severe handicaps (0-24 month skill levels)	No	Profile	89
Gestural Approach to Thought and Expression (GATE)				
(Langley, 1976) (No subscales)	Nondisabled Children (0-36 month skill levels)	Yes**	Score	64
Nonverbal Prelinguistic Communication: A Guide to Communication Levels in Prelinguistic Handicapped Children				
(Otos, 1983) (Tactile, Objects, Gestures & Signs)	Prelinguistic persons with deaf-blindness	Yes	Profile	68
Nursing Child Assessment Feeding Scale and Nursing Child Assessment Teaching Scale				
(Barnard, 1978a, 1978b) (Parent subscales: Sensitivity to Cues, Responses to Distress, Social-Emotional Growth Fostering, Cognitive Growth Fostering, Child subscales: Clarity of Cues, Responsiveness to Parent)	Nondisabled children (Feeding Scale: 0-12 months) (Teaching Scale: 0-36 months)	No	Score	73/76
The Preverbal Assessment - Intervention Profile (PAIP)				
(Connard, 1984) (Visual Awareness, Auditory Awareness, Earliest Interaction, Reflex/Motor, Tactile Acceptance/ Defensiveness, Visual Attending, Auditory Attending, Social Bond Attending, Orienting to Objects, Orienting to Persons)	Infants with severe multiple handicaps (0-8 month skill levels)	Yes	Score & Profile	Observational system

* Cognitive skills addressed in the companion Sensorimotor Performance Profile (Siebert & Hogan, 1982).

** Adapted version developed by Deaf-Blindness Program, University of Washington, Seattle, Washington.

Preference, and Terminate. Since communication is a social behavior, it is not surprising that many of the functions that comprise the ASC subscales are identical to the functions to which communicative behaviors may be assigned (see Stremel-Campbell, 1987). Furthermore, a large proportion of the behavioral indicators that appear under each subscale are communicative behaviors or responses to communicative input. The subscales are arranged into a hierarchy of eight levels ranging from primitive, nonconventional behavior at Level I to adult behavior that may involve sophisticated verbal skills at Level VIII. The scoring system permits the specification of a level of functioning (I-VIII) for each of the 11 subscales. The behavioral indicators are generic and open ended, probing behavior across practical social situations.

The ASC measures a domain of behavior (social competence) of which communicative behavior is an important subset. Therefore, it has the potential to gather a large amount of information about communication from a slightly different perspective than other scales that tend to be organized according to principles of cognitive or communicative development. The ASC has been tested for convergent, discriminant, concurrent, and predictive validity, and test-retest and inter-rater reliabilities have been analyzed.

Callier-Azusa Scale-H

The Callier-Azusa, Scale-H (Stillman & Battle, 1986a) was designed specifically for use with individuals with deaf-blindness. The scale is comprised of four developmental domains: Representational and Symbolic Development; Receptive Communication; Intentional Communication; and Reciprocity. Items in the first two domains are ordered according to a sequence of progressive differentiation and decontextualization between the elements of the communicative interaction. Items on the remaining two dimensions are sequenced according to levels of communicative intentionality. Detailed examples, representative of the behavior of persons with deaf-blindness or severe handicaps, accompany the items. The scale probes for responses in various modalities including gestures, drawings, speech, and sign language and also probes responses to objects used as symbols. The reciprocity subscale includes many dyadic interaction items that do not appear on other scales. Approximate age equivalencies are provided for the items and results may be plotted on a profile sheet.

Communication Placement Assessment

The Communication Placement Assessment, or CPA (Stremel-Campbell, 1984) assesses sensorimotor, social and communication skills, including communicative functions. It was developed for young children and older children or youth with severe disabilities. It is a compilation of items from other published scales as well as some that are original, ordered according to sequences observed in nondisabled children. The CPA yields a visual profile of the student's functioning. The assessment results can be translated directly into IEP objectives, using the IEP worksheet included with the instrument.

Communication Programming Inventory

The Communication Programming Inventory (Sternberg & Adams, 1982) tracks cognition, receptive communication, and expressive communication. The scale reflects van Dijk's movement-based approach to communication intervention and it was designed to assess individuals with severe and profound handicaps. Items were selected from the Callier-Azusa Scale (Stillman, 1978) and Developmental Pinpoints (Cohen, Gross, & Haring, 1976). Each of the three subscales is divided into five levels representing functional age ranges (0-1 month; 1-4 months; 4-8 months; 8-12 months; 12-18 months;

and 18-24 months). The scoring system allows the assessor to determine the age range at which the student is functioning for each of the three subscales. Sternberg and Adams (1982, p. 218) provide a table for translating assessed levels of functioning into procedural levels targeted by their movement-based communication program, which progresses from "pre-resonance" through "final deferred imitation."

Early Social Communication Scales

The Early Social Communication Scales, or ESCS (Seibert & Hogan, 1981) are arranged according to five hierarchical levels of cognitive organization, based upon Fisher's Neo-Piagetian theory of cognitive skills development. These five levels cover cognitive development from 0 to 24 months. The three domains of the scale represent major social communication functions: Social Interaction, Joint Attention, and Behavior Regulation. Within each domain, items reflecting initiating versus responding roles are tracked separately. For the Social Interaction and Joint Attention domains, items reflecting the maintaining role are also tracked separately, resulting in a total of eight subscales. Since the content of the entire scale derives from a pragmatic perspective, communicative function is not tracked separately. The scale is available in both a formal assessment procedure and an interview format. The ESCS yields a score from 0 to 4 indicating level of functioning on each of the eight subscales, as well as a mean level for the whole scale. The companion Sensorimotor Performance Profile (Siebert & Hogan, 1982) is an adapted version of the Ordinal Scales of Psychological Development (Uzgiris & Hunt, 1975), sequenced according to the same five levels of cognitive organization as the ESCS.

Generic Skills Assessment Inventory

The Generic Skills Assessment Inventory, or GSAI (McLean, et al., 1981) addresses generic object relationship, representational, social, and communicative skills, specifically separating dyadic interaction skills. The inventory was developed for use with nonverbal youth and adolescents with severe mental retardation. Because the items are written entirely generically, the scale contains a fairly small number of items (89). Within each domain, the items are organized according to four levels of increasingly complex cognitive organization. The scale yields a profile of abilities, and the results may be translated directly into generic skill objectives.

Gestural Approach to Thought and Expression

The Gestural Approach to Thought and Expression, or GATE, (Langley, 1976) includes nonverbal communication items and related social and cognitive items. The items are not separated into skills domains, however. The items are grouped into levels that represent six age groups between 0 and 36 months of age. The GATE yields a single score of the subject's "developmental communication age." The instrument is not designed to be directly translated into instructional objectives. The original GATE has been adapted for use with students with deaf-blindness by the Deaf-Blind program at the University of Washington.

Nonverbal Prelinguistic Communication

Nonverbal Prelinguistic Communication: A Guide to Communication Levels in Prelinguistic Handicapped Children (Otos, 1983) was developed as an intervention guide rather than an assessment instrument. It is referenced in Table 1-2 because it provides extremely practical information pertinent to communication issues for individuals with deaf-blindness and because it does afford a profile of communication skills for persons

communicating on a prelinguistic level. The guide is mode specific, tracking communication via touch, objects, and gestures/manual signs through nine levels of prelinguistic communication. Generic communication behaviors are specified at each level, and specific examples are provided for each communication mode. The guide provides a response summary indicating a student's communicative skill level for each of the three communication modes. The results of this summary may be translated directly into instructional objectives.

Nursing Child Assessment Feeding and Teaching Scales

Barnard (1978a, 1978b) has developed and extensively researched two scales that measure caregiver-infant interaction. One, the Nursing Child Assessment Feeding Scale (NCAFS) targets the behavior of caregivers and their infants, aged 0 to 12 months, as observed in a feeding interaction. The second, the Nursing Child Assessment Teaching Scale (NCATS), targets the behavior of caregivers with their children, aged 0 to 36 months, as observed in a teaching interaction. These scales are very different from those described previously in that they measure caregiver behavior as well as child behavior, and they assess the overall quality of interaction rather than any specific communicative behaviors. Both scales include four subscales that measure caregiver behavior (Sensitivity to Cues, Response to Distress, Social Emotional Growth Fostering, and Cognitive Growth Fostering), and two subscales that measure child behavior (Clarity of Cues and Responsiveness to Parent). Examples of items from the scales are "Parent pauses when child imitates behaviors during the teaching episode," "Parent varies intensity of rocking or moving the child during feeding," "Parent succeeds in making eye contact with child once during feeding." The NCATS and NCAFS have been extensively normed on a population of infants without disabilities. These scales have the potential to enhance the assessment of communicative competence in young children by addressing the behavior of the caregiver and the efficacy of the interaction between child and caregiver. Both scales yield composite scores.

Preverbal Assessment - Intervention Profile

The Preverbal Assessment - Intervention Profile, or PAIP (Connard, 1984) covers communication and reflex/motor skills from birth to a functional level of 8 months. The PAIP was developed for use with infants with severe and multiple handicaps and covers communication only up to (but not including) the level at which conventional preverbal communication usually begins. The PAIP is divided into three developmental stages, representing developmental ages of 0 to 1 month (Stage 1), 1 to 4 months (Stage 2), and 4 to 8 months (Stage 3). These stages also represent three generic types of behavior: Awareness, Attending, and Orienting. The motor scales are fairly conventional. However, the communication scales track awareness of, and attending to, specific types of visual and auditory stimuli versus human interaction at Stages 1 and 2. At Stage 3, the communication scales assess the mode of the subject's orienting responses to specific objects versus specific types of caregiver behavior. Thus, the emphasis is on receptive rather than expressive communication. Unlike the other instruments cited thus far, the PAIP derives some of its information from administration of observational codes, enabling the calculation of objective scores for such skill domains as early interaction, social bond attending, and orienting to persons. Scores and profiles are provided for each subscale and stage. Forms are provided for translating results into personalized objectives and narrative plans. The PAIP is especially appropriate for assessing individuals who have no clearly intentional communication.

Summary

This chapter has examined a number of difficulties associated with the general assessment of children with dual sensory impairments and/or severe disabilities. This discussion was structured around the distinctions between norm-referenced and criterion-referenced tests. Difficulties peculiar to the assessment of communicative abilities in the target population were then analyzed in the context of discussing the properties of the ideal communication assessment. Finally, 10 instruments that assess communication (directly or indirectly) and that reflect the most current methods in communication assessment were reviewed. All of these instruments reflect the assumption that communication begins at birth. Each instrument has strengths and weaknesses in terms of the scope of behaviors assessed, the level of communicative functioning addressed, and the level of analysis (specific behaviors versus generic behaviors versus overall interactive style). In my opinion, no one of these instruments will capture all that is important in the communicative behavior of children who develop very slowly. However, certain combinations can provide extremely useful information, depending on the level of functioning of the child who is being assessed. It is very encouraging that in the last year two new scales (the Callier-H and the ASC) have appeared that provide significant new insights into the assessment of communication skills in individuals with severe disabilities and sensory impairments.

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II. Research in Tactile Communication

by

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This paper reviews studies that have explored the use of the sense of touch as an aid to communication. The sense of touch, subsequently referred to as the tactile system, has received a great deal of attention as a possible substitute for hearing. For those individuals who cannot benefit from conventional hearing aids, the need to find alternative means for receiving acoustic information from the environment is urgent (Sherrick, 1984). For individuals whose profound hearing loss is accompanied by vision impairment, the need is even more urgent. In general, the studies discussed here indicate that the tactile system offers a viable means for receiving acoustic information. Furthermore, complex acoustic information, such as speech, can be perceived through tactile means (Reed, Durlach, & Braida, 1982). Although the results of investigations on tactile communication devices are encouraging, numerous technical and instructional challenges need to be met before the communication capability of the tactile system is fully understood and utilized.

Tactile communication research has been summarized in excellent reviews by Reed et al. (1982), Sherrick (1984), and the American Speech and Hearing Association Ad Hoc Committee on Cochlear Implants (Hopkinson et al., 1986). Information from these reviews is included in the first section of this paper in order to provide the reader with an introduction to tactile communication. Studies of various methods of tactile communication are described in the second section. Some implications of tactile communication research for communication development in young children with deaf-blindness are discussed in the third section.

Introduction to Tactile Communication

Tactile communication devices, referred to in the literature as spectral displays, tactile vocoders or tactile aids, analyze the acoustic signal into frequency bands and use output of the bands to drive an array of stimulators in such a way that frequency is transformed into stimulation of the skin (Reed et al., 1982). In other words, a sound wave is translated into a signal that can be felt by the tactile system. The simplest type of tactile aid is a single-channel vibrator that translates the speech signal directly to the skin. Multichannel tactile aids code speech frequency by stimulation of the skin in different locations according to the frequency of the signal (Hopkinson et al., 1986). Tactile aids differ in the type of stimulation, number of stimulators, method of encoding amplitude, placement of stimulators, type of display, and method of signal processing (Reed et al., 1982). The person using the tactile-stimulation devices must learn to associate the stimulation with concurrent environmental events.

Tactile aids provide either vibrotactile or electrocutaneous stimulation. The wearer feels a vibration from a vibrotactile device and an electrical impulse from an electrocutaneous device. There is also variability in the functions tactile aids are designed to perform. Relatively simple aids have been developed to serve as supplements to lip reading to provide information about sounds in the environment. The ambitious goal of more complex aids is to provide complete sensory substitution for the auditory system (Hopkinson et al., 1986).

The Tactile System and Acoustic Information

Researchers have used different methods to present acoustic information to the tactile system. Reed et al. (1982) reviewed 16 studies of tactile communication aids. Difference in the equipment used, the subjects tested, and the design and intent of the studies made it difficult to summarize the results or draw conclusions from them. However, the information-processing capabilities of the skin were demonstrated to some extent by all of the studies.

Goldstein and Proctor (1985) described the channel capacity of the skin (the amount of information the skin can receive) as incompatible with perfect transmission of speech. Information rates in bits per second can be calculated for the vibrotactile channel and for the speech signal. If the channel capacity exceeds the signal rate, perfect transmission is possible. If the channel capacity is less than the signal rate, as in the case of the tactile channel and the speech signal, Goldstein and Proctor proposed two alternatives. First, the speech signal can be further processed so that it is within the capacity of the skin. Second, the imperfect transmission can be used as a supplement to another communication method such as lip reading. Goldstein and Proctor considered the second course to be more realistic due to the constraints of current technology; even the most efficient schemes presently available for speech signal processing require information rates about 50 times the channel capacity of the skin. The authors indicated that it is unrealistic, given this limitation, to have as a short-term goal the development of a tactile-only speech communication aid that functions at normal rates of speech. However, less ambitious goals of providing awareness of speech and environmental sounds, and of achieving improvement in lip reading are within reach.

Problems in Tactile Communication

A major problem in tactile communication is the saltatory effect, described by Geldard (1985), who indicated that it should be considered when tactile communication aids are designed. This phenomenon describes the tendency of the tactile system to perceive two taps as being closer together physically as the time between presentation of the taps decreases. For example, if two equally intense taps separated by 5 cm are delivered 200 ms apart and again 300 ms apart the initial pair will be perceived as being physically closer together than the second pair. If only 20 ms separate the two taps, there will be no spatial separation perceived; the distance will seem to have disappeared. The encouraging aspect of the saltatory effect is that it could be used to create intricate patterns, or codes, on the skin. It could interfere with meaning, though, if it generates connections between message segments that should remain separate.

The masking phenomenon is also seen as a factor to be considered in the development of tactile communication aids. Masking occurs when the ability to identify a target pattern is reduced or interfered with by the presentation of other patterns (Craig, 1985). Craig used a device that employed the tactile display from the Optacon to generate patterns on subjects' fingertips. In one experiment sequences of three letters were scanned rapidly across the subjects' fingertips and the subjects were required to identify the first, middle, or last letter. The letter occupying the middle position was the most difficult to identify, presumably because it was interfered with by both the first and third letters. Letters occupying the first position were more difficult to recognize than those in the third position. Craig reasoned that the first letter was more difficult to recognize than the third letter because the former is subjected to backward masking (interference from a succeeding stimulus) and the latter to forward masking (interference from a preceding stimulus). See Butterfield and Belmont

(1971) for interesting alternatives to this theory. Briefly, they demonstrated that altering the acquisition and retrieval methods used by retarded subjects in a memory task resulted in performance that was identical to that of normal subjects.

Craig contended that since masking interferes with identification of a particular pattern or sequence of continuous cutaneous stimulation, it should be eliminated, or at least reduced. Three methods were suggested for minimizing masking: First, increase the time between the presentation of the target stimulus and the masking stimulus; second, decrease the duration of the masking stimulus; and third, increase the spatial separation between the target and the mask.

Franklin (1984) identified additional limitations of the skin that have implications for the development of tactile communication aids. First, the tactile system is relatively insensitive to vibrations; much more power is needed to drive a tactile device than is needed by a hearing aid. Second, the tactile system is unable to feel frequencies that are much above 1000 Hz; some type of frequency-lowering scheme must be included in the tactile aid's processing. Third, since the tactile system is poor at separating signals from noise, special processing is required to eliminate the excitations caused by background noise.

In summary, the tactile system is capable of receiving and transmitting information about sound, but it lacks the sensitivity to easily process speech. Researchers have explored a number of methods to bridge this gap. The studies reviewed in the next section investigated methods and equipment that could be used to maximize the sound processing capability of the tactile system.

Methods of Tactile Communication

The experiments in tactile communication described in this section are organized into three categories: vibrotactile and electrocutaneous aids, the Tadoma method of communication and cochlear implants.

Vibrotactile and Electrocutaneous Aids

The use of vibrotactile aids to assist the communication development of preschool-aged children who have profound hearing losses has been investigated by a number of writers: Friel-Patti and Roeser, 1983; Goldstein, Proctor, Shimizu, and Bulle, 1983; Goldstein and Proctor, 1985; Oller, Eilers, Vergara, and LaVoie, 1986; and Proctor and Goldstein, 1983. The use of vibrotactile aids to improve the lip-reading skills of hearing impaired high school students and adults has been reported (Brooks, Frost, Mason, & Gibson, 1986a, 1986b; Defilippo, 1984; Kaplan, 1983; Oller, Payne, & Gavin, 1980). Studies of vibrotactile communication aids have also been conducted with subjects who have normal hearing (Boothroyd & Hnath, 1986; Brooks & Frost, 1983; Carney, Durkel, & Beachler, 1981; Green, Craig, & Pisoni, 1983; Green, Craig, Wilson, Pisoni & Rhodes, 1983). Studies of tactile aids reviewed in this paper were limited to those involving children with hearing impairments.

Vibrotactile aids have been reported to have beneficial effects on the communication development of preschool-aged children with hearing impairments. Friel-Patti and Roeser (1983) studied four children with hearing impairments to objectively quantify changes in communication that could be attributed to the use of a vibrotactile aid. The children, who were all deafened prelingually, were enrolled in a preschool program for students with deafness. During the study they received three, 30-minute individual language therapy sessions per week. The children all came from intact middle-

class families. The families had participated in parent-infant programs before the children entered preschool. When the study began the children were between the ages of 3 years 10 months and 4 years 6 months. The children were evaluated during one 16-week period in which the aid was worn (aid-on condition) and one 14-week period in which the aid was not worn (aid-off condition). The aid used in the study was the SRA-10. The SRA-10 is a portable, battery-powered device. It consists of a microphone, a processing unit and three vibrators that are worn on the abdomen.

The communication behaviors of the children were assessed four times during the aid-on condition. The four assessments were distributed over the aid-on condition so that performance was measured during the initial, middle, and final stages of the 16-week period. During the aid-off condition, communication behaviors were assessed weekly for 8 weeks. Friel-Patti and Roeser used a communication index and language interaction measures to evaluate the children's communication skills. The communication index was the total amount of time a child used some form of communication: vocalization only, sign only, or combined vocalization and sign. A computer-based observation system and an event-sampling strategy were used to obtain a communication index score for each child. The language-interaction measures assessed were structural language (e.g., total utterances, multiword utterances, mean length of signed utterance) and semantic language.

The communication index data showed a sharp increase in performance during the aid-on condition, followed by a slow decrease in performance during the aid-off condition. The data on structural language showed a general trend for the children's performance to rise during the aid-on condition, then to level off or decrease slightly in the aid-off condition. In the case of semantic measures, there was little difference between the two conditions (Friel-Patti & Roeser, 1983). The authors concluded that the aid improved the use of communication that involved sign language plus vocalization.

In a descriptive study of one child who was deafened prelingually, Proctor and Goldstein (1983) and Goldstein et al. (1983) reported that vibrotactile input was effective in the development of the child's comprehension of spoken language. At the age of 32 months the child began training with a hand-held vibrotactile device. The goals established for the first stage of training were basic communication skills: to develop a consistent response to acoustic stimuli (presented through tactile means); to associate the vibration of the device with a variety of sound sources; to associate the vibration of the device with her own vocalizations; and to increase the rate and quality of her vocalizations. Upon completion of these goals she was fitted with a wearable vest that provided tactile stimulation to her sternum. New language-oriented goals were established: to develop a basic receptive vocabulary; to comprehend a variety of syntactical constructions; to produce sounds and words; and to develop positive social behavior.

No formalized speech and language tests could be administered directly to the child at the start of the project because of her inability to comprehend verbal instructions (Proctor & Goldstein, 1983). Before the study was initiated her parents and preschool teacher reported that she used nasal and vowel-like sounds to make requests. Four consonants occurred infrequently. After 9 months of training with the tactile aid her communication skills had increased to the point that she could understand the instructions of the Peabody Picture Vocabulary Test. At a chronological age of 41 months she had a test age of 30 months. This contrasted with her inability to take the test at a chronological age of 33 months. A record of vocabulary growth was kept by the child's teacher, language therapist, and parents. A word was listed if she consistently responded appropriately more than three times and demonstrated through action, gesture, or

vocalization that she understood. During the period from age 36 to 42 months, her receptive vocabulary approximately doubled each month (Goldstein et al., 1983).

It is interesting to note that her performance during posttraining assessment did not vary across settings (home and school) or across aid-on, aid-off conditions. The aid had not functioned as a sensory substitute because, once the skills were learned, she did not need the aid to perform them. The aid provided additional cues during training rather than substituting for hearing. The authors concluded that much of her impressive gains in speech and language could be attributed to experience with the vibrotactile device (Goldstein et al., 1983).

Greers (1986) conducted a study similar to Proctor and Goldstein (1983) to determine if comparable results would be obtained. They found evidence that the aid facilitated speech production, but the extent to which the aid assisted an increase in receptive vocabulary is not clear. The aid may have helped the child learn a new word, but she relied on lip-reading once she had learned it. The authors concluded that use of the device may facilitate the acquisition of spoken language in a profoundly deaf child.

Oller et al. (1986) used vibrotactile and electrocutaneous vocoders in speech reception and production training with 13 children with profound hearing impairments who were between the ages of 3 and 6 years. Six of the children had been diagnosed as having one or more additional handicapping conditions. None of the children had made significant use of spontaneous verbal language prior to participating in the study.

The electrocutaneous device used was the Teletactor (Saunders, 1974). The Teletactor is a 32-channel vocoder which is mounted on a belt and worn a few inches above the waist. The electrical stimuli, delivered to the abdomen, consist of biphasic pulses of nominally 10 microseconds and 10 milliamps. The frequency of the pulse felt at a particular electrode is proportional to corresponding channel intensity. The other device used was the Oregon vocoder (Engleman & Rosov, 1975). The Oregon vocoder's stimulators are solenoid vibrators contained in four plastic cartridges. Two cartridges were strapped to each thigh so that the highest frequency channel was 9 to 12 inches above the left knee, and the lowest frequency was at the same location on the right leg. Middle frequency channels were near the knee. The authors pointed out that in spite of the differences in form of stimulation, both devices transmit similar information (Oller et al., 1986).

The children's communication skills were assessed by recording and phonetically transcribing speech samples. Based on recorded samples and transcriptions, each child's inventory of phonemes and substitution patterns was analyzed, and individualized training goals selected. After approximately 70 hours of individual training, the children's skills were reassessed and compared to pretraining performance. Imitative as well as functional use of speech improved over the year. All the children showed progress in speech production. All but one of the children reached a criterion of 80% correct on receptive, two-choice identification tasks. (The authors noted that the children with multiple handicapping conditions made the least progress.) There was no measurable difference in performance of the two vocoders; both groups of children made similar progress. A control group was not used in this study; however, it is stated that an appropriate comparison group is currently being followed.

W. J. Gavin (personal communication, July 29, 1987) is currently studying the effect of feedback from a 24-channel tactile vocoder on speech reception and production in children of preschool age with moderate to profound hearing impairments. The children

in Gavin's studies do not receive training specific to use of the tactile aid. The aid is worn during the time the children are attending their preschool classes and provides an additional form of sensory input.

Gavin, Woodard, Mathy, and Harr (1987) reported a study to determine if a multichannel tactile device could serve as an active feedback mechanism in the production of speech. Five children were presented with tasks to elicit spontaneous and imitative speech. Each subject was tested in two sessions, one with the 24-channel tactile device operating and one when the device was not operating. Comparisons of articulation performance were monitored by trained observers who did not know when the device was operating. Articulation errors, as judged by the observers, increased during the session when the aid was not activated, but the differences between the two sessions were not statistically significant. Gavin et al. proposed that detailed analysis of the children's productions through acoustic analysis would increase the sensitivity of the data and more precisely define the nature of the articulation improvements. This analysis is in the process of being conducted.

Tactile communication devices have been used as a method to improve the lip-reading abilities of high school students and adults. Oller et al. (1980) found that adolescents with hearing impairments learned to discriminate some hard-to-lip-read words after about an hour of training with a vibrotactile aid. Kaplan (1983) reported that the receptive language skills of an adult who was deafened postlingually increased after he received training with a vibrotactile aid. DeFilippo (1984) included subjects with and without hearing impairments in a study to compare lip-reading ability in aided and unaided conditions. Although subjects differed in the degree of benefit received, they all demonstrated that speech features can be perceived from tactile cues, and can be combined with information received visually to facilitate comprehension.

Wearable tactile aids that are sufficiently portable, light, and durable for use by young children are, for the most part, still in the developmental stages. With the exception of the Tactaid I (see Table II-1), the wearable aids used in the studies reviewed were prototypes and are not available commercially. However, some types of tactile aids can be purchased. Table II-1 provides a brief description of four tactile aids recommended for use by persons with deaf-blindness. For additional information about assistive tactile devices for deaf-blind persons the reader is referred to the resources listed in Table II-2.

The Tadoma Method of Communication

Chomsky (1986) reported on the linguistic abilities of three adult subjects who were deaf and blind. Two of the subjects, deaf-blind since infancy, had acquired language and learned to speak through Tadoma. The third subject began learning Tadoma after he lost his vision and hearing at age seven. The linguistic knowledge and productive language of the subjects were analyzed by standardized tests (WAIS, WISC-R, Stanford-Binet), and tests constructed for the study. The subjects' language abilities were extensive. Vocabulary skills compared favorably with hearing individuals. The syntactic abilities of all three subjects were excellent in comparison with a deaf population. The subjects' oral and written language was fluent and mature.

The three Tadoma users demonstrated a command of English that exceeded that of many persons with deafness and, in some areas, were comparable to individuals with normal hearing. The author indicated that various factors may have contributed to the successful use of Tadoma by these subjects: The subjects received many years of one-to-one training in the method; the nature of the Tadoma display (a talking face) is such

Table II-1: Tactile Aids for Persons with Deaf-Blindness

<u>Item</u>	<u>Description</u>	<u>Sales/Services</u>
Tactile Acoustic Monitor	Pocket-sized tactile sound monitor, vibrations felt from wristband can distinguish sounds, such as door bell, telephone	Summit 74 Wheellys Road Edgbaston, Birmingham B15 2LN England
Tactaid I & II	Two vibrators worn on sternum or wrist; one vibrator reacts to high frequency, one to low	Dahlberg Sciences LTD. P. O. Box 9022 Kitchener, Ontario Canada N2G 4J3 (800) 265-8250
Tactile Speech Indicator	When coupled with a telephone handset the device converts signals received into vibrations 1 vibration = No 2 vibrations = Yes 3 vibrations = Please repeat	Helen Keller Nat'l Center for Deaf-Blind Youth and Adults 111 Middle Neck Road Sands Point, NY 11050
TAC-COM	Device for paging deaf-blind persons and for use as fire alarm	Sensory Aids Evaluation & Development Ctr. Massachusetts Institute of Technology 77 Massachusetts Ave. Cambridge, MA 02139

Table II-2: Guides to Aids and Assistive Devices

<u>Title</u>	<u>Author/Date</u>	<u>Publisher/Address</u>
A Complete Guide to Communication with Deaf-Blind Persons	Kates, L., & Schein, J. 1980	National Assoc. of the Deaf 814 Thayer Ave. Silver Spring, MD 20910
A Manual of Augmented Sensory Feedback Devices for Training Severely Handicapped Students	Campbell, P., McInerney, W., & Middleton, M. 1982	Children's Hospital Medical Ctr. of Akron 281 Locust Street Akron, OH 44308
International Guide to Aids and Services for the Deaf-Blind	Gill, J. M. 1986	Research Unit for the Blind Brunel University Uxbridge, Middlesex England
Assistive Devices for Deaf-Blind Persons	Thompson, J. 1987	CNIB Deaf-Blind Services 1919 Bayview Ave. Toronto, Ontario M4G 3E8 Canada

that the user has access to multidimensional information about the speech signal: vibration, air flow, and lip and jaw movements; Tadoma combines learning to produce speech with learning to perceive it; and the use of the hand in Tadoma may provide a significant receptive advantage over tactile systems that use other body sites. The author also pointed out that none of the subjects was multiply handicapped. Chomsky concluded that the study demonstrated that the skin is able to transmit sufficient information about speech to allow the development of language.

Reed et al. (1985) studied nine adults with deaf-blindness who had received extensive training in Tadoma as children and continued to use the system for speech reception. For these subjects, the onset of deafness and blindness was essentially simultaneous and occurred between the ages of 18 months and 7 years. Speech reception and linguistic abilities were assessed with formal tests. Subjects were also tested on the ability to identify consonants and vowels in nonsense syllables. Performance on the W-22 word recognition test (Hirsh et al., 1952) ranged from 26 to 56 percent correct across the nine subjects. The Speech Perception in Noise test (Kalikow, Stevens, & Elliott, 1977) scores for low-probability sentences ranged from 20 to 54 percent. Measures of continuous speech showed that seven subjects were able to identify key words, presented at half the normal speech rate, with 65 to 85 percent accuracy. One subject scored 48 percent correct and one subject was unable to complete the test. The authors concluded that speech reception at moderate rates and with moderate accuracy is possible through the tactile sense.

The success of Tadoma users prompted Reed et al. (1985) to initiate studies of augmented Tadoma and synthetic Tadoma. The augmented Tadoma system is an attempt to improve the ability to identify speech segments by providing the user with information about the location of the tongue of the speaker. The equipment used for augmented Tadoma includes an electro-palotograph (Rion DR-01), which senses the tongue contact pattern, and the transducer portion of the Optacon, which displays the tongue position information. A programmable interface (DEC LSI - 11) is used between the palotograph and the Optacon. The synthetic Tadoma system is an attempt to duplicate a human speaker's facial actions with an artificial mechanical skull in order to identify essential cues for understanding speech through Tadoma. The mechanical face is driven by computer-controlled signals that are formed from speech information received by facial action sensors. The facial actions that produce laryngeal vibration, oral airflow, and various articulatory movements can be sensed by the device and replicated by the mechanical face. No data on artificial or synthetic Tadoma research were presented.

Cochlear Implants

Cochlear implants are receiving growing attention as a means to provide awareness of sounds, to relieve the isolation of being deaf and to assist in lip reading (Goldstein & Proctor, 1985). Cochlear implants change sound into electrical current in an attempt to directly stimulate remaining auditory nerve fibers. Implants provide a sensation of sound that may partially approximate what the implantee experienced before losing his or her hearing (Pickett & McFarland, 1985). The report of the American Speech and Hearing Association (ASHA) Ad Hoc Committee of Cochlear Implants (Hopkinson et al., 1986) summarized the diversity of views regarding cochlear implants. One reason indicated for the diversity of opinion about cochlear implants is the extreme difference in performance among implant users. An implant may provide no benefit to some patients and may allow significant word recognition in others. There are more than 1,000 cochlear implants in adults with profound deafness throughout the world. Most of the users of implants are adults who were deafened postlingually but several investigations are being conducted with children. Preliminary evidence from the adult studies suggests

that cochlear implants are a viable technique to assist in the rehabilitation of profound postlingual hearing loss, although many questions remain unanswered (Hopkinson et al., 1986).

The ASHA Committee advised caution when considering an implant for a young child; if a child is benefiting from a hearing aid or tactile aid, it is questionable whether a cochlear implant would supplement this information. Findings from a study of young children who were fitted with implants indicated an increased awareness of sound, increased attention to faces of speakers and some modification of vocalization (Eisenberg, Berliner, Thielemeir, Kirk, & Tiber, 1983). Similar results have been obtained with vibrotactile aids. Young children who are deafened prelingually benefit from cochlear implants about as much as they benefit from vibrotactile aids (Goldstein & Proctor, 1985).

Pickett (1986) suggested the combination of an implant and a tactile aid. Implants immediately provide sensations of sound but require major surgery. Tactile aids require a learning period but are more easily obtained than implants. Pickett concluded that since the information provided by implants and tactile aids is partially nonredundant further gains might be obtained with a hybrid system.

According to the authors of the ASHA report (Hopkinson et al., 1986), there are several factors that should be considered before a child receives an implant. One factor is that the implant may have an adverse effect on any residual hearing in the implanted ear. Even slight residual hearing offers more information than an implant. A conservative approach is to ensure that the child has no usable residual hearing. Another potential problem is the susceptibility of children to otitis media. Intracochlear implantation provides a path for infection to travel from the middle ear to the brain. (This has not been reported for any children who have implants.) Physical implantation in a growing child presents possible problems. The size of the cochlea does not change after a child is a few months old, but the structures surrounding the cochlea continue to grow. Electrodes fixed to these structures may shift position over time. The authors recognized the successful use of implants by some children, but they concluded that it is undesirable to implant children who are less than 2-1/2 years old.

Implications for Persons with Deaf-Blindness

Persons with deaf-blindness who have learned to understand and produce speech through the primitive means of touching the face of the speaker have demonstrated that the tactile system can provide an avenue of sensory input when hearing and vision are not available. Teaching young children with deaf-blindness to capitalize on the capabilities of the tactile system is a challenge for teachers, parents, and therapists. Results from the studies reviewed in this paper indicate that use of tactile aids may assist the communication development of young hearing impaired children, but these results cannot be generalized to children who have dual sensory impairments, particularly if the sensory loss is combined with motor and/or intellectual impairment. At least three questions arise when considering the use of tactile aids by young children who are deaf and blind: a) Is a wearable aid available? b) What are the training requirements? and c) What are the effects of tactile aids on the communication development of deaf-blind children?

In answer to the first question, wearable tactile aids are not widely available (see Table II-1). Most of the available research data pertain to devices that generally are not available for clinical use. In addition, the aids that are being tested may not meet the needs of the deaf-blind child who also has a motor impairment. The difficulties of producing an aid that is lightweight, durable, and sufficiently sensitive to be useful are

only partially solved. The portable aids worn by Gavin's preschoolers are fairly heavy. Proportionally, the weight of the apparatus to a preschool child is roughly comparable to an average-sized adult wearing a 30- to 35-pound pack (W. J. Gavin, personal communication, July 29, 1987). Even though the children manage the weight successfully, work is being directed toward decreasing the weight of the device. The weight and positioning of the device may present greater problems to the nonambulatory child. For example, the posture and mobility problems experienced by children who have cerebral palsy could be magnified by additional weight. As with the weight factor, placement of the aid presents different challenges for ambulatory and nonambulatory children. If a child's method of locomotion is creeping or bellycrawling, the entire ventral side (the preferred side for stimulator placement) is inaccessible. Of course, the child's back is available, but the back is not a preferred site for stimulator placement due to frequent movement of the muscle groups of the back.

We simply do not have sufficient information to answer the second and third questions. Oller et al. (1986) recognized that a multiply handicapped child may require more intense training experiences with tactile aids than a child who experiences only a hearing loss. However, the method(s) of training a deaf-blind child to learn to use a tactile aid is a matter for speculation. It is not yet known if vibrotactile aids can assist the communication development of the target population.

It seems reasonable to assume that if one's auditory and visual systems are significantly impaired, learning through the tactile mode would be a viable consideration. Further, since there is clear evidence that some persons with deaf-blindness have not only learned to understand speech, but are also able to produce speech using their tactile modality (Tadoma method), it also seems reasonable to assume that with today's technology, lightweight, wearable tactile communication devices could be developed that would significantly improve a person's ability to gain information about the environment. Most of the research and development efforts have been directed toward designing communication devices for normally developing children and/or adults with deafness. Other than the research involving the use of the Tadoma procedures, no studies were located that involved subjects that were both deaf and blind. Further, much of the research and development efforts have been directed toward developing a complete sensory substitution system for the auditory systems. Rather than waiting for the development of a lightweight, wearable device that can be a complete sensory substitution system, we need to focus research and development specifically upon discrete subgroups of persons with deaf-blindness.

Currently, the label "deaf-blind" includes an extremely divergent population that can vary from being intellectually gifted to profoundly retarded. They can range from legally blind and able to read large print to those who are totally blind and cannot perceive light. Their hearing can range from ability to perceive loud speech sounds to inability to perceive even the loudest noise. Motor control can vary from above average dexterity to little or no control of the major muscle groups. The age of onset for each of these sensory impairments can be anytime between birth and death. The Tadoma method may be appropriate for an individual who is profoundly deaf and blind with average or above intellect, who has relatively good hand and arm control, and whose sensory impairments began early in life. Would this be the procedure of choice for the same person if he or she had sufficient vision to read large print? How about the person who is several standard deviations below the mean on intellectual development?

Research is needed, and the efforts of rehabilitation engineers, educators, language specialists, and others should be directed toward this investigation. Concurrent with these national research and development efforts is the need for making the existing

equipment commercially available. Also, experimental equipment should be accessible to teachers and other researchers. Because of the extremely "thin" market for such technology, the cost of necessary research and development activities is prohibitive for profit-oriented organizations. Thus, federal and/or nonprofit sources of funding will be essential for the completion of this work.

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III. Visual Assessment

by

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Traditional techniques for assessing the visual system include methods for determining the structural intactness of the system, as well as measuring its capacity for providing various forms of visual input to the cortex. Historically, many of these assessment techniques could not be used unless the persons being assessed could communicate what and how well they see. This precluded the participation of very young children and others with limited communication skills. Ironically, it is this same group that can benefit most from early detection and treatment of visual dysfunction. Recent advances allow for more complete visual assessment of preverbal individuals. These newer techniques are described in this chapter.

Assessment of the visual system serves three major functions for persons with deaf-blindness: (a) initial detection of the visual impairment, (b) diagnosis and treatment of ocular pathology, and (c) evaluation of residual vision for purposes of education and rehabilitation. The following sections describe various visual assessment procedures that have been used with young children to fulfill one or more of these functions. Only those procedures viewed as having potential applicability for the target population of 0 to 6-year-olds with deaf-blindness have been included.

Initial Detection

The importance of the early detection of an impaired visual system cannot be overstated. Many of the more severe types of visual impairment can be corrected, or their effects ameliorated, through early detection and treatment. Most types of visual impairment become less amenable to treatment as the age of the child and the duration of visual deprivation increases. As noted by Salapatek and Banks (1978), the presence of ocular abnormalities such as strabismus, cataracts, astigmatism, and myopia during infancy and early childhood is correlated with deficits in subsequent adult vision even if the ocular abnormality is eventually corrected. Bower (1977) and Raab (1980) also note that the benefits of restored vision are markedly reduced when treatment such as removal of congenital cataracts is delayed until after 6 months of age. Consequently, it seems reasonable to assume that some individuals with deaf-blindness would have less severe impairment had their visual dysfunction been detected and treated at the earliest possible opportunity.

Early detection and treatment of vision problems is especially important for children with developmental delays. A survey by Gardner, Morse, Tulloch, and Trief (1986) found that 44% of multihandicapped neonates had an accompanying visual impairment. Warburg (1986) reported data from screening 7700 children with mental retardation in Denmark; these data indicate that the prevalence of severe visual impairment was 200 times greater than for children without mental retardation. Ellis (1986) reported that the prevalence of all degrees of visual impairments in people with mental retardation is ten times higher than in the normal population. Ellis concludes that the higher prevalence of sensory handicaps is "sometimes from the same congenital source as that which produced the mental retardation, sometimes because mundane limitations on vision or hearing have been ignored or overlooked, and occasionally as a side-effect of the pharmaceutical treatment of other conditions or 'problems'" (p. 1, Introduction).

There are reports in the literature of large-scale screenings of young children by professional eye examiners (Friedman, Neumann, Hyams, & Peleg, 1980; Ingram, Traynar, Walker, & Wilson, 1979). However, such services are not currently available to most young children. Research has also been reported in the use of photographic techniques for screening large numbers of infants and young children for visual disorders (Braddick & Atkinson, 1982; Day & Norcia, 1986; Howland & Sayles, 1983; Kaakinen, 1979). Photographic techniques can detect problems of refractive error and eye alignment, as well as the presence of opacities such as congenital cataract. For example, a technique called photorefracton involves the use of a 35-mm camera with flash unit. The child being refracted fixates a target (e.g., the camera itself or a toy held close to the camera) and the resulting photograph yields an image of the light flash as it is reflected off the eye's fundus. Day and Norcia (1986) reported success with children 8 weeks and older using their photorefracton technique. The widespread use of these mass screening tests would presumably have a significant effect on the early detection of vision problems.

The most commonly used vision-screening tools are the tests of visual acuity. In the past, children below 3 years of age were routinely excluded from preschool vision screening programs because of their inability to perform on standard visual acuity tests such as the Snellen E. Other visual acuity tests have been developed for use with younger and/or developmentally delayed children involving simplified responses such as matching letters (Lippman, 1971) and naming or matching pictures (Allen, 1957; Faye, 1968; Mabry, 1982). To illustrate, in the HOTV test (Lippman, 1971), the child being tested is given a response panel displaying the four letters. A wall chart containing the letters H, O, V, and T is located 10 feet from the child. The child performs a matching function by pointing to the letters on the response panel that correspond to those on the wall chart. The Preschool Vision Test (Allen, 1957), the Lighthouse Flashcard Test (Faye, 1968), and the Efron Test (Mabry, 1982) all utilize flashcards displaying line drawings of objects (one per card). Depending on the test used, the cards are held at various distances from the child being tested (ranging from 10-20 feet) and the child must label or match the pictures. A test developed specifically for children with handicapping conditions, the Parsons Visual Acuity Test, includes operant conditioning of the desired motor response to a visual test target (Cibis et al., 1985; Cress, Johnson, Spellman, Sizemore, & Shores 1982). None of these tests are particularly effective for children under 2 years of age, although the Parsons Visual Acuity Test has been used for testing a large number of children whose developmental age was considered to be well below 2 years of age.

A promising new approach to the measurement of visual acuity in infants and young children has resulted from the work of Fantz (1963) and others in the study of infant visual preferences. One of their findings was that infants consistently preferred to look at a patterned, rather than a plain, or homogeneous, viewing target. This result has been used to develop a method for testing visual acuity known as "preferential looking." When presented with a pattern on an otherwise plain background, the child will fixate the pattern if he or she is able to detect it. Visual-acuity testing using the preferential-looking paradigm usually involves the presentation of a black and white grating, or striped target, of varying sized gratings that is paired with a plain grey target of equal luminance. The capacity to detect the stripes on an otherwise plain background involves the use of resolution acuity, as opposed to traditional tests that measure recognition acuity (i.e., the ability to either label a stimulus or discriminate it from other stimuli). Although the relationship between recognition and resolution acuity is still being investigated, it appears that the two factors are highly and positively correlated ($r = .789$ in a study by Mayer, Fulton, & Rodier, 1984). Advantages of the resolution task include the requirement of a far less sophisticated response from the

individual being assessed than in recognition acuity tests. Also, the response most often used in this assessment approach, visual fixation, is present in most humans at birth or shortly thereafter.

Discussion of applications of the preferential-looking (PL) acuity test to persons with developmental disabilities have appeared recently in the literature (Cress, in press; Duckman & Selenow, 1983; Lennerstrand, Axelsson, & Andersson, 1983; Mayer, Fulton, & Sossen, 1983; Mohn & Van Hof-Van Duin, 1983). Populations in these studies included children with Down syndrome, cerebral palsy, and other developmental disabilities, as well as adults with severe multiple handicaps. In all of these studies it was found that the majority of the subjects were testable with the PL technique. Of particular importance, Mayer, Fulton, and Sossen (1983) and Cress (in press) found that PL acuity scores for subjects with developmental disabilities were poorer than expected for the subjects' ages. Mayer et al. (1983) determined that this decrement covaried with the severity of the developmental delay and hypothesized that impairments in central nervous system functioning and/or motor development, as well as attention and motivation factors, may account for this poorer PL performance. Interestingly, it has been shown that later neurological disorders were better predicted for infants by a PL discrimination task than by a neurological examination (Fagen & Singer, 1983).

Most recently, a simplified PL test has been developed (Dobson et al., 1986; McDonald et al., 1985). This "acuity card" procedure involves the manual presentation of standard PL stimuli by the observer who judges whether each card, containing a stimulus of known grating size, can be seen by the subject. The cards are presented directly in front of the child being tested at distances of 38 cm, 55 cm, or 84 cm depending on the age of the child. The grating sizes correspond to Snellen equivalent acuity scores. The use of the Teller Acuity Cards in mass screening of infants was discussed by Dobson et al. (1986). They found that 95% of their subjects aged 16 days to 32 months were successfully tested for acuity, 79% of these subjects yielded 2 monocular acuities (each eye separately tested), and total test time averaged less than 15 minutes.

Although PL viewing distances vary slightly from study to study, most procedures approximate traditional near-point acuity testing (less than 2 feet). Cornell and McDonnell (1986) described a PL test procedure using the 20-foot test distance typically used for distance or far-point acuity testing. Results with infants from 6 to 36 weeks old were consistent with results gained at the shorter test distances. They concluded that PL testing can be accomplished at the 20-foot distance and that viewing distance did not have a significant effect on the child's ability to resolve striped patterns. This finding is particularly significant if the procedure is to be used for the screening or assessment of older populations. School-aged children are more likely than preschoolers to have, or develop, myopia (nearsightedness) so vision-screening programs for this age group should include far-point acuity testing whenever possible. Further, knowledge of a person's distance acuity can be useful in the design of orientation and mobility training programs, modifications of learning environments, and similar programming issues.

Current research with the Teller Cards has focused on the use of the technique with children with specific types of visual impairment (Birch & Stager, 1985; Mayer & Fulton, 1985; Mayer, Fulton, & Hansen, 1985; Teller et al., 1986). Cress (in press) reported on the use of the Teller Cards to assess visual acuity of children with deaf-blindness and those with varying degrees of mental retardation and other handicapping conditions.

Diagnosis and Treatment

Children who fail on vision-screening tests or who are otherwise suspected of having visual problems should be referred to a professional eye examiner (ophthalmologist or optometrist). Professional eye examiners utilize a number of procedures to determine the type and extent of visual impairment and to measure the effectiveness of their attempts to treat the problem. The most widely used techniques for evaluating the young child's visual status involve the direct inspection of the physical characteristics of the eye. These techniques include ophthalmoscopy (inspection of the anterior portions of the eye such as the retina, macula, and aqueous humor), retinoscopy (determination of the refractive status of the eye), and the evaluation of eye muscle balance, various fixation tests, and measures of eye alignment, dominance, and motility.

Depending on the findings of these initial examination techniques, additional procedures may be used to refine or clarify the diagnosis of visual impairment. An increasing amount of research is being reported regarding the use of electrophysiological measures, especially the visual evoked potential (VEP) and the electroretinogram (ERG), in the diagnosis and treatment of visual impairment in newborns and very young infants.

The VEP measures cortical stimulation that results from the presentation of controlled visual stimuli. The simplest version of this procedure involves the use of a circular fluorescent light, often called a "flash-ring," while electrodes attached to the head transmit data on the neural response to this stimulus to a computer for summation and graphing. The flash-ring is sufficiently intense that the person being evaluated need not be conscious and the results can prove useful in locating optic lesions, tumors, and any other serious pathology or anomaly. Kurtzberg (1982) recommended that infants with low birth weight and others considered to be at high risk be screened at the gestational age of 40 weeks, with the flash VEP to detect abnormalities in the visual system.

The flash-ring VEP has limited usefulness, however, when questions of specific visual functions arise. For such issues a more elaborate VEP procedure, referred to as pattern VEP, has been developed. It employs a computerized graphics display of various patterns to assess visual functions such as acuity (Dobson and Teller, 1978; Fagan & Yolton, 1985) or use of visual fields (Wolfe, 1979). Unlike the simpler technique, limited cooperation from the person being assessed is required. The child must tolerate the placement of electrodes to the forehead and various cranial locations and must orient, with eyes open, to the monitor presenting the graphics display.

Numerous reports can be found documenting the use of the pattern VEP procedures to detect visual impairment by testing the visual acuity of infants (Baraldi, Ferrari, Fonda, & Penne, 1981; Braddick & Atkinson, 1982; Kurtzberg, 1982) and young children with neurological handicaps (Dubowitz, Mushin, Morante, & Placzek, 1983; Mohn & Van Hof-Van Duin, 1983). Most researchers have found a tendency for the VEP to overestimate acuity in young children when compared to behavioral measures (Dobson & Teller, 1978), and some children show wide differences between VEP and behavioral acuities (Baraldi, et al, 1981). Dobson and Teller (1978) hypothesized that these differences may relate to the more stringent criteria used in behavioral studies or that information about the stimulus may reach the visual cortex but "... is not available for behavioral expression" (p. 1481). In addition, some individuals may be difficult to test with pattern VEP procedures. Persons who withdraw from tactile stimulation, have poor neck and head control or frequent seizure activity, and those who tantrum often or have high frequency stereotypic behaviors (e.g., head shaking or rocking) may not tolerate the placement of electrodes to the head for the duration of testing. An additional requirement in pattern

VEP testing is the maintenance of visual orientation to the graphic display. This behavior may be difficult to elicit from some individuals, especially those persons with little interest in the visual stimuli or who are otherwise noncompliant.

Despite these limitations, VEP procedures are seen as a significant advance within the medical community. Recent articles by Kurtzberg (1982), Moskowitz and Sokol (1983), and Smith (1984) reflect an increased effort to study the clinical applications of the VEP. Moskowitz and Sokol conducted a normative study with 439 subjects from 1 month to 5 years of age. Their attempt to establish age norms for various stimuli in current use is a significant step toward more effective use of the VEP. Smith (1984) provided a brief but practical discussion of the problems encountered in clinical application of the VEP, which should be a valuable guide to other clinicians using electrophysiological procedures with infants and young children.

Sokol (1986) discussed the clinical applications of the VEP and ERG in the pediatric age group. His experience indicates that from birth to 8 weeks of age the flash VEP is useful in monitoring the central nervous system development of high-risk newborns and may be a good predictor of future neurological and developmental handicaps. By 8 weeks of age, reliable pattern VEPs can be recorded and used to estimate visual acuity, to evaluate the effectiveness of optical correction for refractive error, to detect amblyopia, to monitor the effects of occlusion therapy, and to differentiate between cortical blindness and developmental delay. Sokol suggested that, at any age, the ERG can be used in conjunction with either the flash or pattern VEP to differentiate between retinal and cortical blindness. His conclusion was that the VEP and ERG are valuable in evaluating the visual systems of infants and young children and should be used in combination with other procedures such as preferential-looking acuity tests and measurement of refractive error.

Evaluation of Residual Vision

Young children who are diagnosed as deaf-blind often have at least some residual visual sensation. According to the National Society to Prevent Blindness (1980) approximately 40% of legally blind preschool children are considered "totally blind" and the remaining 60% have at least partial visual capabilities. Curtis and Donlon (1983) reported the results of a 10-year followup study of children with deaf-blindness in which they found that 20% of the subjects were considered totally blind and approximately half the children were visually capable of reading print. Data presented by Fredericks and Baldwin (1987) indicate that at least 45.8% of individuals considered deaf-blind have useful residual vision.

Knowledge of the child's current visual functioning is essential to the process of planning effective interventions for young children who are deaf-blind (Friedlander & Knight, 1973; also see Chapter X, this volume). Mathy-Laikko, Ratcliff, Villarruel, and Yoder discuss in Chapter X many of the variables involved in selecting appropriate alternative communication systems for this population, one of which is the extent of residual vision possessed by the child in question. A thorough visual assessment may provide valuable information regarding optimal stimulus placement, size, color, or intensity; and environmental factors such as ambient lighting conditions and usefulness of various visual aids. The effectiveness of an intervention can be dependent on the use of stimuli and settings that provide the child maximal visual input.

Since the effects of a visual impairment vary from case to case and across time within an individual, it would be erroneous to assume that medical records alone can predict the visual functioning of children with deaf-blindness. Curtis and Donlon (1983)

found that only 37% of the subjects in their study showed a stable degree of visual loss after 10 years; 41% showed better vision after 10 years; and 22% had poorer vision. Also, Gottlieb and Allen (1985) reported that 22% of a group of children with hearing impairments who had previously received a professional eye examination had been misdiagnosed. Nonetheless, information found in up-to-date eye examination reports can provide a useful set of initial hypotheses when evaluating the residual vision of a child with multiple handicaps.

Evaluation of a child's residual vision should incorporate information based on the type of visual impairment possessed by that individual. The most common causes of blindness in children are cataracts, optic nerve atrophy, and retrolental fibroplasia (National Society to Prevent Blindness, 1980). The typical effects of these and other visual disorders are known, and this information can be used to formulate an initial evaluation strategy. Todd (1981) provided information regarding the characteristics of 24 visual impairments, including modifications of educational environments, which have been beneficial for persons with such impairments. For example, a child with cataracts could be expected to have reduced visual acuity and normal visual fields, to prefer dim to average lighting, and to benefit from some type of magnification. The selection of visual assessment procedures for this child would include measures to determine the extent to which this general finding applies to the individual in question, as well as to identify other possible deficits in visual behavior.

For purposes of planning interventions for a young child with deaf-blindness, a thorough assessment of the child's functional vision is needed. Assessment of functional vision includes both formal and informal observation of the child's responses to various types of visual stimuli. Such assessments typically include measures of visual acuity, ocular motility (including visual behaviors such as tracking and shift of gaze), use of visual fields, and eye-hand coordination.

Several tools for assessing functional vision have been developed for use with special populations. Langley (1980) developed the Functional Vision Inventory for Severe and Multiply Handicapped. Rock et al. (1983) described a procedure they call the Low-Functioning Assessment Kit. Sailor, Utley, Goetz, Gee, and Baldwin (1982) developed a visual assessment manual that was intended for use with school-aged students who are deaf-blind. Efron and DuBoff (1979) included a visual assessment in their Vision Guide for Teachers of Deaf/Blind Children.

The results of functional vision assessments can be used not only to determine the child's current visual functioning but can also assist in selecting target skills for teaching visual behaviors. Research by Utley, Duncan, Strain, and Scanlon (1983), and Goetz and Gee (1987a), as well as numerous studies reviewed by Lundervold, Lewin, and Irwin (1987) demonstrate that persons with visual impairment can learn to see better. Goetz and Gee (1987b) presented a model for functional vision programming which emphasizes natural contexts, motivational factors, and age appropriateness while pairing the targeted vision skill with teaching objectives from other domains.

For children with the most severe vision deficits, a more individualized assessment strategy may be needed. As noted by Friedlander and Knight (1973), determining the parameters of a child's visual deficiency can lead to more effective interventions. Johnston (1985) discussed an ecological approach to the study of infant perception, which appears equally relevant to older persons with limited sensory capabilities. This approach emphasizes naturalistic observations of the individual in his or her normal setting, especially related to the presence and absence of responses to sensory stimuli. Once stimuli that elicit responses are identified, a "reductionist analysis" could be

followed to determine the specific aspects of those stimuli that are controlling the responses. This approach appears consistent with the movement in other educational assessment domains toward an ecological analysis of behavior. It is especially responsive to the unique sensory and response characteristics of young children with sensory impairment.

A study by Friedlander and Knight (1973) provided an example of how a reductionist analysis might be employed to evaluate residual vision. Their subjects were 16 preschool children with deaf-blindness and retardation. Two slide projectors and two screens were employed to present various levels of illumination on either the left or right side of the subject's visual field. The first phase of the study involved training the subjects to operate a two-choice lever, with either choice resulting in the onset of a lighted stimulus (illumination of one of the two screens). Included in this training was the learning of the contingency relationship between the switch activation and the onset of the illumination light. (Schweigert, Chapter IX in this volume, provides a discussion of contingency learning and possible intervention approaches.) Subjects were then tested for their sensitivity to varying degrees of brightness. Once the subjects' threshold for light intensity had been obtained, the second phase of the experiment began. In this phase activation of the lever to the left or the right produced different levels of illumination or brightness. The subjects' brightness preferences were then assessed. The authors suggest that the same paradigm could be used to assess the boundaries of a child's visual sensitivity to color, movement, contour, and other stimulus variables.

Assessment procedures designed for purposes other than visual assessment may also be useful in identifying the parameters of a child's visual capabilities. Jones, Schulte, and Walker (1984) described a procedure for determining the toy preferences of profoundly multihandicapped persons. This procedure involves up to 36 different toys and provides a system for evaluating various stimulus characteristics of the toys, including color, amount of visual and tactile pattern, complexity of contour, size, complexity of moving parts, amount of reflection, plasticity, and noise production. The results of this assessment could provide useful information regarding a child's visual capabilities and preferences. The system for coding of stimulus characteristics could also be used independently of the entire procedure for informal observation of the child's responses to environmental stimuli and for the selection of stimuli to be used in educational interventions.

Summary

The previous sections have contained descriptions of various procedures for assessing the visual systems of infants and young children. The procedures have been used to identify children with abnormal vision, to diagnose visual impairment and monitor the effects of treatment, and/or to determine the amount of residual vision in children with uncorrectable vision problems. The widespread use of these procedures could have a significant impact on the population of young children with deaf-blindness through the provision of more appropriate and timely medical and educational interventions.

Of greatest interest to educators and support personnel serving children with deaf-blindness is the assessment of residual vision. As mentioned previously, existing procedures are often insufficient for this purpose, especially for those children who have severe handicaps such as retardation and orthopedic handicaps in addition to their sensory impairments. For these children, a more individualized approach is needed. The literature cited provides a point of departure in the development of an individualized assessment strategy that could determine the parameters of a child's impaired visual capabilities for the purpose of planning educational interventions. Future investigation

should be directed toward synthesizing existing knowledge into an assessment and decision-making process that is sensitive to the unique characteristics of young children with deaf-blindness and other accompanying handicaps.

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IV. Hearing Evaluation of Infants and Children at Risk for Severe Hearing and Vision Deficiencies

by
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Infants and children who are suspected of being deaf and blind present major evaluation problems. These problems are often stated as a series of questions: "Does the child hear anything?" "Is failure to respond to auditory stimuli a function of peripheral sensory problems, or is it a function of more central neurological problems?" "To what degree are the hearing problems correctable through medical treatment and/or prosthetic devices?" "What are the best modes to use for communicating with and teaching the child?" These very important and practical issues fall into two general classes--questions that are important for medical management and treatment, and questions that are important to educational management and intervention. The purposes for hearing evaluation are somewhat different in medical management and educational management. Thus, different procedures may be more useful in one area than in the other.

This chapter provides a summary of procedures for evaluating the hearing of infants and children who are difficult to test. The manuscript is divided into three major sections: Immittance/impedance audiometry; evoked potential audiometry; and, behavioral audiometry. Each section provides a brief overview of the procedures and evaluates their potential for use with difficult-to-test persons. Each section also discusses the limitations and benefits of each technique.

Immittance Audiometry

Static compliance, tympanometry, and acoustic reflex evaluation constitute the three main measurements of immittance/impedance audiometry (Orchik & MacKimmie, 1984). These are objective measures of middle ear function and require no instructed behavioral response on the part of the subject.

Static Compliance

This is one measure of middle ear function that aids in evaluation of the mobility of the middle ear system. Historically, this test procedure is referred to as acoustic impedance. It is usually expressed in terms of equivalent volume air (in cubic centimeters) under two conditions—one with positive pressure equal to +200 mm of water at the tympanic membrane and the second with the membrane in its most compliant point (Northern & Downs, 1978, p. 158). Since the static compliance measure is based on the volume of air made at only two pressure values, it provides limited information and is considered by Orchik and MacKimmie (1984) to be the least useful of the three immittance measures. Further, because many otologic pathologies produce compliance values that overlap normal middle ear compliance values (middle ear compliance is influenced by many variables including the patient's age and sex as well as pathologic state, Northern & Grimes, 1978), the static compliance measure, used alone, must be considered with great caution. To make matters worse, Jerger (1980) reported that the measure yielded a high percentage of false positives when used to detect otitis media in children.

Tympanometry

Tympanometry is a procedure that measures the relative change in eardrum compliance as air pressure is varied in the external ear canal (Orchik & MacKimmie,

1984). Because air pressure is varied across a wide range, the measurement gives a good picture of the compliance of the tympanic membrane. Tympanometry is one of the most effective procedures for detecting effusion associated with otitis media. In a comparison of tympanometry with standard puretone audiometry, Bluestem, Berry, and Paradise (1973) evaluated 34 children with both tympanometry and puretone testing. They found that of 34 children who had puretone thresholds of better than 25 dB hearing threshold level (HL), 16 exhibited serious otitis media when they were subjected to myringotomy. All of these 16 subjects had abnormal tympanograms. Eight of these children had puretone thresholds better than 15 dB (HL), so it is clear that normal threshold does not rule out severe otitis media. Normal tympanograms do, however, rule out severe otitis media. When tympanometry and puretone audiometry are combined, they are quite effective in the identification of otitis media.

Of course, the utility of tympanometry is not limited to children with otitis media. Tympanometry will be responsive to any abnormality of the middle ear that results in changes in compliance at the tympanic membrane—these include interruption of the chain of ossicles, frozen ossicles, middle ear tumors, and a perforated tympanic membrane. It is clear that tympanometry is a valuable clinical tool for the detection and medical management of an abnormal conductive mechanism and the abnormal function of the Eustachian tube.

Acoustic Reflex Thresholds

Acoustic reflex thresholds "represent the minimum intensity that will result in detectable reflexive contraction of the stapedial muscle" (Orchik & MacKimmie, 1984). Both puretones and broad-band signals have been used for testing. If the middle ear is normal, the inability to obtain an acoustic reflex indicates a sensorineural loss. Often the procedure for evaluating sensorineural loss is based on the difference between the reflex threshold obtained with puretones and the reflex threshold obtained with broad-band noise. According to Jerger, Hayes, and Anthony (1978), the smaller the difference between these two thresholds, the greater the likelihood of a sensorineural loss, although some researchers have used absolute threshold for broad-band noise.

The acoustic reflex is quite accurate in predicting sensorineural loss in children between 2 and 12 years of age. Whether the acoustic reflex is useful for evaluating infants younger than age 2 is questionable. Abahazi and Greenberg (1977) reported on the tests for the acoustic reflex with 62 infants from 1 to 12 months of age. Only 23 of the infants demonstrated the acoustic reflex for white noise, 500 Hz, 1000 Hz, and 2000 Hz tones. On the other hand, Gerber, Gong, and Mendel (1984) reported that they tested 45 infants between 12 and 36 weeks and all subjects yielded acoustic reflexes. Acoustic reflexes occurred at an average level of slightly above 70 dB for a broad-band noise and at about 80 dB for 4000 Hz tones. The procedures followed in these studies were not described in sufficient detail to determine the source of the difference. One could conclude, based on these data, that if an acoustic reflex is obtained from an infant in response to the 500 Hz, 2000 Hz, and 400 Hz tones, the infant has normal hearing. The absence of such reflexes under 1 year of age may or may not indicate a hearing deficit. Stimulus configurations, ipsilateral versus contralateral presentation (McMillan, Bennett, Marchant, & Shurin, 1985), and stimulus type, noise, or tone (Sprague, Wiley, & Goldstein, 1985) must be considered carefully in evaluating the auditory behavior of neonates.

Implications for the Target Population

Immittance audiometry would appear to have its greatest use in detecting middle ear pathology. Tympanometry is extremely useful for making referrals to otologists for

medical management. Since the same apparatus is used for evaluating the acoustic reflex as is used in tympanometry, it is cost and time effective to test for sensorineural losses concurrently with obtaining a tympanogram as well as many central auditory processing disorders associated with neuropathologies (Hall, 1985). If the child does have middle ear pathology, however, failure to obtain an acoustic reflex may have little meaning. It should be made clear that acoustic reflex abnormalities have been seen in behaviorally disturbed, language-delayed children (Thomas, McMurry, & Pillsbury, 1985) with normal hearing. Additionally, the acoustic reflex can be used to predict hearing sensitivity, particularly in children with mental retardation (Givens & Bronerwine, 1983; Poole, Sheeley, & Hannah, 1982).

Since immittance audiometry depends on placing a plug in a child's ear and obtaining a tight seal; the procedure depends somewhat on having a cooperative child. Prior to 1 year of age, standard immittance audiometry is probably not feasible for quick screening. A relatively new and simple approach to detecting middle ear disease with effusion has been described, however, by Teele and Teele (1984). The technique, known as acoustic otoscopy or acoustic reflectometry, is a noninvasive objective method that requires no hermetic seal and is reportedly useful even if a child is crying or when there is partial obstruction of the canal (Schwartz, 1986; Schwartz, Schwartz, & Daly, 1984). As this is a new technique, considerable care should be used in interpretation of the results (Buhrer, Wall, & Schuster, 1985).

Tympanometry, the most reliable procedure involved in immittance audiometry, is designed to determine the compliance or lack of compliance in the middle ear system and is useful in detecting and diagnosing a variety of middle ear pathologies. For that reason it is a very important tool, both in the otology clinic and also for evaluators who want to detect pathology so that referrals can be made to otologists. The utility of tympanometry for educational management also lies in its ability to monitor middle ear function over a long period of time. Although the effects of chronic middle ear disease on child development are not yet clear, the mediating variable, hearing loss, represents a hazard to cognitive development (Kavanagh, 1986).

Evoked Potential Audiometry

Evoked potential audiometry is based upon the fact that surface electrodes can be attached to various locations on the head, and electrical potentials from the brain can then be recorded. If an auditory or visual stimulus is presented repeatedly and the potentials following each stimulus presentation are cumulated and averaged, waves of positive and negative potential begin to occur at varying periods after the stimulus presentation. Although different stimulus and analysis configurations are necessary to maximize specific evoked responses, three temporal periods following the presentation of auditory stimuli are generally found to be important (Moore, 1983). Early or fast responses occur in the first 10 milliseconds (msec) following the stimulus, middle-latency responses occur between 10 and 50 msec, and late responses occur 50 to 500 msec following each stimulus presentation.

Auditory Brainstem Response (ABR)

The most widely used evoked potential procedure has involved analysis of the first 10 msec following stimulus presentation. The 10 msec of activity presumably originate in the ear and the neural structures of the ascending auditory pathways of the brainstem. Generally, analysis of the first 10 msec of activity has resulted in five waves (peaks). The time between Waves I and V, an interpeak latency, has been used most in diagnostic work. Onset of Waves I and V varies with age; however, by about 1 to

3 years of age, the wave forms of infants closely approximate those of normal adults (Salamy & McKean, 1976). There is also evidence that the peak latencies may be different due to gender. Latencies are longer in males than females, particularly for Wave V (McClelland & McCrea, 1979). Since Waves I and V are present in normal newborns, brainstem audiometry is viewed as a technique with great value for evaluating the auditory system of very young children with severe handicaps (Hecox, Gerber, & Mendel, 1983; Jerger, Hayes, & Jordan, 1980; Murray, 1988; Stockard, Stockard, & Coen, 1983). Brainstem audiometry is also insensitive to medication, sleep state, and even anesthesia, and hence requires little or no subject cooperation.

Jerger, Hayes, and Jordan (1980) reported on their use of ABR with 167 children, between 4 days and 83 months of age, referred by otolaryngologists, audiologists, pediatricians, neurologists, school districts, centers for children with multiple handicaps, and university speech and hearing centers. Of the 167 children, 136 required sedative medication for evaluation with the most frequently used medication being chloral hydrate. In a small number of cases, chloral hydrate was used with demoral, phenergran, and thorazine. Stein et al. (1987) have also successfully evaluated the ABRs of 122 institutionalized children with mental retardation under these medications.

Within the sample studied by Jerger et al. (1980) were 31 children with such neurological problems as cerebral palsy, Down syndrome, cerebral atrophy, hydrocephalus, microcephaly, and seizure disorders. Of these children, nine (or 30%) gave no ABR at 90 dB (HL). Eight yielded ABR thresholds between 50 and 90 dB. Jerger et al. interpreted these results as ruling out severe peripheral losses for the 14 children who obtained ABR thresholds between 0 and 40 dB. They concluded that the results for the remaining subjects were ambiguous because their lack of ABRs may have been due to a peripheral hearing loss and/or a neurological disorder. Cross-checks with impedance audiometry and behavioral audiometry showed perfect agreement on the subjects who yielded no ABR even to the 90 dB (HL) signal. Others have successfully relied on a test-battery approach to evaluate the hearing of individuals with mental retardation (Squires, Ollo, & Jordan, 1986).

In addition to providing information relative to peripheral hearing intactness, ABR can provide diagnostic information regarding white-matter neurological disorders. A lengthened interpeak duration is associated with abnormal nerve myelination that occurs with phenylketenuria and maple syrup urine disease (Rowe, 1981). Conversely, a reduced interpeak latency is often seen in infants and adults with Down syndrome (Folsom, Widen, & Wilson, 1983; Squires et al., 1986).

Middle-Latency Evoked Responses (MLR)

A less widely used procedure involves the evaluation of waves between 10 and 50 msec after stimulus presentation. These brain potentials seem to arise from the very high brainstem structures and association cortex of the temporal lobe (Polich & Starr, 1983). Like the brainstem responses, the middle-latency response waves are largely unaffected by sleep or medication (Mendel & Goldstein, 1971). Unlike brainstem-evoked responses, however, the MLR waves are diminished by complete anesthesia (Goff, Allison, & Lyons, 1977, reported in Mendel, 1983). Several investigators have noted promise of MLRs as an audiological diagnostic tool for young children and newborns.

Wolf and Goldstein (1978) reported that the middle-latency waveforms of five normal neonates (24 to 96 hours of age) were similar to those obtained from adults and older infants. Further, responses could be obtained at mild stimulus levels (about 30 dB) using 1000 Hz tone pips and objective, computerized scoring procedures could be

uniformly utilized to evaluate the data. Mendelson and Salamy (1981) also have reported success in recording the middle-latency responses from 15 premature infants as well as 15 full-term newborns and other children and adults.

Late Auditory Evoked Potential Evaluation

The early work on auditory evoked potentials consisted largely of evaluation wave forms occurring beyond 50 msec; these wave forms were affected by a variety of conditions such as sleep state or medication. For these reasons, these later components have proven impractical for auditory evaluation when prediction of hearing loss is desired. The late responses (LRs), when carefully used, can be significant in evaluating central auditory responses to sound and cognitive processing of auditory stimulus (Kileny, 1985; Kileny & Berry, 1983). If the late responses are used as a suprathreshold device (i.e., no attempt to vary the acoustic signal parameters for auditory thresholds) their status should correlate well with central dysfunction.

Robier et al. (1983) reported on the use of ABR and LR evaluation of 24 difficult-to-test children between 2 and 14 years (mean age about 6½ years). Of these children, five showed no reproducible waves at 90 to 100 dB (HL). One child demonstrated I and V waves but showed increased latency between the I and V waves. Eighteen children showed normal I and V waves and normal latencies between I and V. Of the five subjects who showed no reproducible waves, four of them had profound bilateral sensorineural losses and the fifth child showed left temporal lobe damage. When LRs were evaluated for the 24 children, 10 showed normal or near-normal LR waves. Four children showed the absence of PI waves but, otherwise, the LR waves appeared normal. Ten children showed so much variability that the different LR waves were unidentifiable. Of the five children who showed no ABR, none showed responses on the LR. The subjects who showed a prolonged latency on the ABR also showed no LR. Of the 18 subjects who showed normal ABR, 10 showed normal LRs and 8 showed either no responses or pathological middle-latency responses.

Implications for the Target Population

In recent years the ABR has achieved great popularity among audiologists who test infants and severely handicapped children because it requires no cooperation from the client, yet yields reliable data even on newborn infants (Swigonski, Shallop, Bull, & Lemons, 1987). Moreover, in many cases it allows for differential diagnosis of conductive and sensorineural losses.

There have been occasional problems, though, such as the limited number of children who have no sign of ABR even from high intensity sounds, but who show normal or near-normal puretone thresholds on audiometry (Worthington & Peters, 1984). Also, it is risky to equate functional hearing abilities with ABR results in patients with neurological impairments. An additional limitation on the utility of ABR is the requirement of sedation; ABR must be used in settings in which the subject can be managed medically. The limitations notwithstanding, Stein, Ozdamar, and Schnabel (1981) have shown the success of ABR testing with 82 children with developmental delays and who were suspected of being deaf and blind (age range 12 days to 10 years). Conclusive data on hearing ability for this group could not be obtained through conventional audiological procedures.

The results obtained by Robier et al. (1983) suggest that more children will show pathology on LR evaluation than ABR evaluation. Exactly what abnormal LRs mean when normal ABRs are found is currently unknown. However, the presence of the MLRs

and late auditory evoked potentials with normal ABRs would provide strong evidence of normal peripheral and central auditory function.

Finally, evoked-potential equipment is still somewhat expensive and thus may be limited to those settings that can provide comprehensive evaluation. Nevertheless, evoked-potential audiometry is a standard tool to measure acoustic sensitivity with difficult-to-test populations. In view of (a) the sometimes questionable relation between auditory evoked potentials and a person's ability to voluntarily respond to an auditory stimulus, (b) the requirement of medical surveillance of a sedated subject, and (c) the expense, auditory evoked-potential evaluation would seem most useful in medical management and research. Its implications for educational management are yet to be fully determined, although the cognitive components of the late-evoked responses might be used to monitor progress with central nervous system impairments following various habilitative interventions.

Behavioral Audiometry

Behavioral audiometry is used in this chapter to refer to any of a variety of procedures in which a sound is presented and the subject's behavior is recorded either mechanically or by an observer. Behavioral audiometry may simply capitalize on a basic reflex, or may involve classical conditioning, operant conditioning, or in some cases may be based on a combination of all of these basic behavioral processes.

The most commonly used behavioral audiometry procedure is standard puretone testing. In this technique, the audiologist verbally instructs the client that tones will be presented and that the client should tell the audiologist when he or she hears the tone. This procedure, of course, works well with clients who understand verbal instructions, but is of little use in evaluating clients suspected of having deaf-blindness.

Another commonly used technique for evaluating the hearing of children is play audiometry. This procedure involves modifications of standard puretone audiometry so that the child is given a specific play response such as putting a ring on the peg each time a tone is presented. The audiologist may verbally instruct the child concerning the rules of the game or may simply present the tones and put the child through the expected response. After the child completes the response when the tone is presented, audiometric testing may proceed. The play audiometry procedure may be useful with older children suspected of being deaf and blind, but it requires behavior that infants and children with severe handicaps simply do not exhibit.

Behavioral Observation

This procedure involves presenting a sound, often a noise, and then observing whether the infant or child makes any response to that noise. Usually if the noise is loud (90+ dB) the first time it is presented to an infant or child, there will be a startle reaction. In an infant lying in a supine position, that reaction may take the form of a Moro reflex. That is, almost immediately after the noise is presented, the infant will extend his or her arms and then bring them to the chest. The response may take the form of a jerking movement, change in facial expression and widening of the eyes. If the young child or infant is in an active state, the response may constitute a cessation of activity for a brief period of time. Successful use of sound to suppress vocal behavior (crying) in neonates has been reported by Riccillo, Topping, and Watterson (1984), and Watterson and Riccillo (1983, 1985).

There is little doubt that infants without handicaps show reactions to loud sounds at or soon after birth, and that children with unimpaired hearing will continue to respond to sounds. However, the form of the response is so varied across infants, and even within the same infant across time, that obtaining reliable observation of reactions has been the subject of considerable concern (Bench, Collyer, Mentz, & Wilson, 1976a, 1976b). Ling, Ling, and Doebling (1970) conducted a careful study on the use of behavioral observation with neonates. They presented three different sound stimuli (narrow-band noise centered around 2000 Hz or 3150 Hz or a tone varying between 2000 to 4000 Hz) presented at 85 dB (SPL). One observer's ears were masked by noise presented through earphones so that the observer could not hear when the test sounds were being presented. A second observer could hear the test sounds. The observer who was masked reported more false-positive responses (responses when no sound had been presented) than the unmasked observer. Ling et al. also reported that within three presentations of the same stimulus, the response began to adapt so that the initial stimuli could be expected to evoke a response only a few times prior to habituation. Additionally, the intensity level of the stimulus has to be quite high (above 80 dB, SPL) to evoke an observable response under most conditions.

Recent research into scoring techniques with children with and without handicaps has improved the usefulness of behavior observation testing (Flexer & Gans, 1985, 1986; Gans, 1987; Gans & Flexer, 1982, 1983), and careful selection of sound stimuli must be made (Rosenberg & Butler, 1982). Behavioral observations may be useful in telling whether a child is deaf and should yield some information about the functional use of sound by the subject. Careful observation should also aid in the selection of stimuli used for sensory assessment or reinforcement for educational management, as specific stimuli or reinforcement objects do not work with all subjects. Certainly the combination of behavioral observation of responses to sound (functional sound discrimination) and objective physiological response to sounds allows for full assessment of auditory abilities (Dahle & McCollister, 1983; Shepard, 1983).

Tangible Reinforcement Operant Conditioning Audiometry (TROCA)

TROCA is based on the use of a change in sound as a discriminative stimulus. A correct response to the stimulus (a button press) is followed by delivery of a bit of food, drink of liquid, or other potential tangible reinforcer (Lloyd, Spradlin, & Reid, 1968). Through the immediate delivery of appropriate reinforcers, the procedure teaches the client to press a button each time an auditory stimulus changes. If the client presses the button after the auditory stimulus changes, a chime rings, a food receptacle lights up, and the reinforcer is delivered. If the child presses the button when an auditory change has not occurred, nothing happens except that the onset of the auditory change is delayed for 3 to 5 seconds following the response. TROCA was initially developed to evaluate the hearing of persons with moderate to severe mental retardation who were untestable with nonoperant behavioral techniques. When used properly, the technique proved effective with over 90% of the ambulatory clients with severe mental retardation.

TROCA has a number of advantages over other behavioral audiometric procedures. First, since the discriminative stimulus is a change in a constant stimulus, it allows for obtaining thresholds for puretones and detection of small increases in intensity on a tone baseline (Small Increment Sensitivity Index, SISI), in gaps in tones, any other discrete change in the sound field (Fulton & Spradlin, 1972; Fulton & Waryas, 1974), and complex pitch-perception ability (Waryas & Brandt, 1977). It can be used for free-field testing, with ear phones, or with bone conduction. Since TROCA allows for repeated evaluation using the same basic response—signal presentation and reinforcers—

it provides a means for completing rather comprehensive hearing evaluations as well as for monitoring hearing performance across time. TROCA's disadvantages are that it (a) requires, in addition to an adequate signal generator, a specific-response apparatus and reinforcement-delivery apparatus, which are somewhat bulky and may not be readily available; (b) may require extensive pretraining for 10 or more sessions to establish stimulus control for severely retarded persons; (c) is limited to subjects who have adequate motor responses; and (d) is not useful for even normal infants below 7 to 9 months of age.

Audiometry Using Sound Localization

Turning one's eyes or head toward the source of a sound is a very primitive response. Sound localization responses occur in newborn infants, but the reliability of these responses is low. By 4 and 5 months of age, though, reliable eye movement or head-turning responses toward the source of complex sounds do occur (Clifton, Morrongiello, Kulig, & Dowd, 1981; Morrongiello & Rocca, 1987). In the Clifton et al. study, there was no visual stimulus associated with either the presentation of the sound or the response of the child, and only a limited number of stimulus presentations occurred (12 in one study, 16 in a second study). The early neonatal localization responses are probably innate reflexes which are adaptive not only to human infants but also to lower organisms. By the time a human infant is 4 to 5 months old, the localization response is probably partially under operant control. Suzuki and Ogiba (reported in Wilson & Thompson, 1984) introduced a procedure in which a puretone was introduced at 30 to 40 dB above the child's estimated hearing threshold; then 1 second later, an illuminated doll was presented in the same location as the sound source. The tone and visual stimulus both remained on for 4 seconds. After a few presentations, the visual stimulus was delayed and presented only after the head-turn response. This procedure proved successful in obtaining threshold estimates on over 80% of children between 1 and 3 years of age. Successful threshold estimates were determined on less than 50% of the children under 1 year of age. Wilson and Thompson and their colleagues have refined the procedure for visually reinforcing a head-turning response toward a sound source and report fairly reliable responding to puretones with normal children as young as 5 months. They reported the presentation of a variety of complex visual stimuli, contingent on head turning toward the source of a sound, including a dancing bear and other animated toys. They also reported good success in assessing hearing ability in children with Down syndrome (Wilson, Folsom, & Widen, 1983).

Goetz, Gee, and Sailor (1983) described a procedure using visually reinforced localization responses for multiply handicapped children. In their procedure they presented a flashing light to the subject and noted whether the subject turned toward the light. They began conditioning by presenting a sound and the light simultaneously and then began to gradually delay the onset of the light. On some occasions probe trials were presented in which only the sound occurred. If the subject turned toward the sound source on a probe, the flashing light was presented, as well as social reinforcement and tangible reinforcers. Systematically collected data demonstrating the success of the procedure have been presented for three children with multiple handicaps.

Morrongiello and Rocca (1987) recently demonstrated age-related improvements in sound localization ability in the frontal, horizontal plane of infants (6-18 months of age) based on auditory cues alone. However, accuracy in sound localization, as measured by head orientation to signal location, did not vary across age when visual and auditory cues were available. This was not a reinforcement study, and Morrongiello and Rocca discuss their results in terms of the normal utilization of information gained from one modality (e.g., vision) to direct attention to the other modality (e.g., audition) at least in the frontal regions of the subject.

The advantage of sound localization with visual reinforcement procedures for evaluating hearing is that it capitalizes on a natural response—eye glance or head turning. Moreover, the visual reinforcer is a natural reinforcer so the possibility for rapid conditioning seems likely. The procedure is useful with normal children as young as 5 to 6 months. The disadvantages of the procedures are that (a) they require a system for operating visual reinforcers, and the visual reinforcers themselves; (b) visual reinforcers may lose their effectiveness after repeated trials; (c) some infants with severe visual problems may not be reinforced by visual stimuli; (d) reflexes or responses that may be well developed in normal children may not appear in severely handicapped children.

Uses of Vibration in the Hearing Evaluation

As it is possible that children who are blind may not respond to a visual stimulus, it is logical that a tactile stimulus might prove useful as a reinforcer for a head-turning response toward the source of a tone. Specifically, the first step in the procedure would be to place a vibrator against one of the child's cheeks and then activate it. If the vibrator proved reinforcing, the child would be shaped to turn his or her head toward the vibrator when touched on the cheek, after which the vibrator would be activated. Once the child reliably turns his or her head in response to the touch, a sound could be paired with the touch, and then the touch faded in intensity or duration until the head-turn was under the control of the sound alone. As in the Goetz et al. (1983) procedure, the vibrator could be accompanied by social and/or tangible reinforcers.

Frisina (1962) presented a procedure in which a bone-conduction vibrator was used as the discriminative stimulus in play audiometry. First the vibrator was presented on the back of the child's hand, and the child was prompted to put a ring on the peg when stimulated with the vibrator. The vibrator was then placed on the child's forehead. The child was then tested in response to bone-conducted sound at octave intervals through 400 Hz. After bone-conduction testing, a puretone air conduction was administered. Generalization of stimulus control from bone-conduction testing to air-conduction testing was reported to occur reliably. According to Frisina, this procedure is adaptable for children with mental ages as young as 22 months who will accept earphones. Although the procedure may not meet the requirements for evaluating young children with deaf-blindness, the use of a vibrator (tactile) stimulus and the shift of control from that stimulus to an auditory stimulus deserves exploration.

Considerable research on tactile devices as communication aids for subjects with deafness has taken place in recent years (Sherrick, 1984). Much of the research compares the performance data of these persons on visual and tactile devices and cochlear electrical implant devices (Pickett, 1986). The research can be summarized easily by stating that tactile devices can be useful for subjects with deafness or deaf-blindness in learning and changing communication skills (Chomsky, 1968; Friel-Patti & Roeser, 1983; Geers, 1986; McGarr, Head, Friedman, Behrman, & Yudelman, 1986).

Even though considerable research is still needed to eliminate artifact in the responses, bone-conduction stimulation has been used to evoke electrical potentials from the auditory system. ABRs, MLRs and frequency-following responses (FFRs) have been measured in individuals considered as deaf, following a bone-conduction stimulus. Such responses suggest that low-frequency hearing may still exist and be useful in such persons, a result not apparent from traditional assessment procedures (Cornacchia, Martini, & Morra, 1983; Hicks, 1980; Hooks & Weber, 1984; Ribaric, Padovan, & Prevec, 1984, 1985; Ribaric, Prevec, & Kozina, 1984).

Implications for the Target Population

Auditory stimuli may function as eliciting stimuli and discriminative stimuli but then can also serve as reinforcing stimuli (Primus & Thompson, 1985). Friedlander (1968) presented various vocal stimuli contingent on knob-pressing responses for young children (11-15 months old) and demonstrated that certain auditory stimuli could increase the rate of knob-pressing responses. Clearly, if an infant increases responses when auditory stimuli are presented contingent on those responses, the infant must hear those stimuli. Moreover, if the child reliably makes more responses when certain vocal stimuli are presented, as compared to other vocal stimuli, then the subject is discriminating among those stimuli (see also Johansson & Salmivalli, 1983; Rosenberg & Butler, 1982). An unexpected use of sound as a reinforcer of behavior and an aid in educational programming and management for persons with deafness has been suggested by Darrow's music therapy techniques (Darrow, 1979, 1984, 1985; Darrow & Starmer, 1986).

Other investigators (Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Morse, 1974), studying infant auditory perception, have studied a nonnutritive, high-amplitude sucking response under various conditions in which contingent auditory stimuli were presented. Typically the infant is presented a pacifier-like nipple. After a baseline of responding is established, a brief (less than 1 second) auditory stimulus is presented each time the infant sucks at a specified intensity. Rate of sucking often increases, and if the rate increases reliably, then it can be assumed that the infant heard the stimulus. This same response is often used to evaluate the infant's capacity for discrimination. One vocal stimulus is repeatedly presented to the subject until response rate decreases by about 20%, and then a new vocal stimulus is presented. If response rate increases reliably, then the infant discriminates between the two stimuli. Recent research has demonstrated the ability of neonates (4- to 5-day-olds) to discriminate between speech signals (Bertoncini, Bijeljac-Babic, Blumstein, & Mehler, 1987).

These procedures (based on presenting auditory stimuli contingent on responses) have the advantage of being acceptable to persons with very limited skills and development. This is especially true with the high-amplitude sucking response. Since the sucking response is present soon after birth, it allows for the evaluation of very young infants. There really is no problem when response rate differences are demonstrated between baseline and contingent auditory stimulation. Such differences indicate that the infant hears the stimulus. When there is no difference between baseline and contingent auditory stimulation, however, it may not be because of a failure to hear, but only due to lack of reinforcing properties of the auditory stimulus. The high-amplitude sucking response has been used widely in group studies of the auditory perception of infants, but research that reliably demonstrates intrasubject differences is very limited. For this reason, the use of contingent auditory stimuli will probably remain limited as a procedure for evaluating the auditory processes of infants suspected of being deaf-blind.

Summary

This chapter reviewed techniques for evaluating the hearing of infants and other difficult-to-test subjects. There were no attempts in the report to review the causes of hearing deficiency, the specific relation of hearing deficiency to the development of speech or language, or the saliency of different types of auditory signals used as stimuli. Within the last 10 years, the evaluation of auditory processes of infants and persons with handicaps has advanced rapidly. It should be obvious that no single assessment procedure will tell how a subject "hears." With the technological innovations in objective audiometry (i.e., immittance/impedance and evoked potential audiometry)

and greater understanding of behavioral processes, the combination of physiological and behavioral methods make the assessment of infants and other difficult-to-test subjects not so difficult from a technical point of view. The reader who wishes more in-depth information than provided here will find the publications listed on the Selected Bibliography useful. Greater detail can be found in the references accompanying the report.

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V. Nonsymbolic Communication in Early Interactional Processes and Implications for Intervention

by

Ellin Siegel-Causey, Barbara Ernst, & Douglas Guess

Normal communication development is centered within the interactions and relationships between infants and their primary caregivers. The multiple impairments of young children with deaf-blindness or severe disabilities may limit these early interactions. "Current research underscores the importance of the very earliest social interchanges for the origins of communication" (Cole & St. Clair Stokes, 1984a, p. 7).

This chapter provides an overview of early communicative exchanges and identifies variables that might affect the development of communicative competence. Specifically, it focuses on the development of nonsymbolic, prelanguage communication and the interactional context within which it occurs. First, important aspects of nonsymbolic, prelanguage communication are reviewed, focusing on caregiver sensitivity and responsiveness to the infant's early visual, gestural, and vocal behaviors. Then, salient features of caregiver behaviors are examined, including the use of visual, gestural, and vocal behaviors. The second section presents early communicative behaviors between caregivers and infants as an evolving interactional process. Caregiver sensitivity, timing, contingency and predictability are important components of early interaction processes. These aspects are examined in relationship to both the normally developing infant and to the child with deaf-blindness who is at the nonsymbolic level. The final section explores differences in interactional patterns of caregivers with children displaying disabling conditions, covering such areas as caregiver initiation, overstimulation, directive and controlling behaviors, and differences in interactional patterns over time.

Significant Aspects of Prelanguage Communication

In recent years interest has increased in the study of mother-infant interactions (Appleton, Clifton, & Goldberg, 1975; Bakeman & Brown, 1977; Bullowa, 1979; Clark & Seifer, 1983; Hayes, 1984; Kelly, 1982; Schaffer, 1977; Snow, 1984; Uzgiris, 1979). This is explained partially by a shift in the general theoretical orientation of child development toward a wider acceptance of the viewpoint that infants are active contributors, as opposed to passive members, of the mother-infant dyad (Hayes, Goodnow, & Murray, 1984; Murray & Trevarthen, 1986; Schaffer, 1977; Stone, Smith, & Murphy, 1973). Research documents the infant's active participation in the environment, including the ability at birth to discriminate and respond to a wide variety of signals (Carlson & Bricker, 1982; Kagan, Kearsley, & Zelazo, 1978; Newson, 1977; Richards, 1974; Sherrod, Crawley, Peterson, & Bennett, 1978; Trevarthen, 1977). A young infant smiles, cries, and uses various facial expressions, eye contact, gestures, and vocalizations in response to the immediate environment (Als, 1979; Bakeman & Brown, 1977; Hayes, 1984; Sugarman, 1984). By using this wide array of communicative signals, infants are immediately able to express their needs by demonstrating a range of recognizable emotions from boredom, interest, anxiety, contentment, discomfort, and even a sense of humor (Adamson & Bakeman, 1984; Bruner, 1975; Newson, 1977; Odom, 1983).

At birth the infant is endowed with the basic biological equipment to begin interpersonal communication (Goldberg, 1977; McClowry & Guilford, 1981; Sachs, 1984; Schaffer, 1977). Investigations of the interactions between mother and infant have led to the realization that the newborn infant is socially precocious. Infants exhibit a

powerful social motivation to interact with others, demonstrated by their early preference for human faces and early recognition of the human voice (Bates, Bretherton, Beeghly-Smith, & McNew, 1982). Carlson and Bricker (1982) explain that the biologically intact infant is predisposed to initiating social interaction. Research indicates that several behaviors are used by the infant to elicit social contact. These include crying, sucking, smiling, clinging, following, reaching, and fussing (Als, 1979; Bowlby, 1969). These behaviors are particularly important because infants need to evoke a social response immediately in order to satisfy their physical comforts. Infants also appear to exhibit a natural proclivity for smiling and cooing to social stimuli adult caregivers may use (i.e., caresses, vocalizations, and smiles). Moreover, the infant's responses of smiling and cooing may motivate the adult to reply in turn. A surprising degree of organization is seen in the mutual gaze patterns, smiling, vocalizations, touching, and other aspects of social exchange in the caregiver-infant relationship (Bates, et al., 1982).

Most literature on the development of language focuses on the acquisition of verbal skills (Bloom, 1970, 1973; Goetz, Schuler, & Sailor, 1979; Miller, 1981; Miller & Chapman, 1984; Nelson, 1973). Some authors studying the processes of language development, however, assert that the prelanguage stage is a critical time for acquisition of linguistic and nonlinguistic skills (Seniefelbusch & Pickar, 1984; Snow, 1984; Sugarman, 1984). The prelanguage stage has been described as a period involving a high level of communication (Bricker & Carlson, 1980; Coggins & Carpenter, 1981; Newson, 1977; Odom, 1983), particularly between the infant and primary caregiver. The infant's preverbal communicative behaviors are seen as precursors to the communicative functions of language (Kuczaj, 1986). The nonsymbolic, prelanguage stage and its role in the progression of communication development is important since "... exchanges clearly do become meaningful to the child, as well as to the mother, well before verbal language can be considered to be the operative factor" (Newson, 1977, p. 50).

Long before infants have any understanding of spoken language, they are ready to take an active part in the social interchange with a primary caregiver (Newson, 1977). As soon as they have any control at all over their movements they begin to build an extensive system of signals for their nonsymbolic conversations (Rogow, 1984; Zinobar & Martlew, 1985). As early as 3 months of age, caregiver and infant are engaged in an intricate, reciprocal, and precisely timed dialogue. Infants have learned many ways of gaining their caregiver's attention and keeping the conversation going (Zinobar & Martlew, 1985). The thrust of recent developmental research shows that (a) infants do communicate before they talk and (b) this communicative ability evolves during the first year of life (Bates, 1979; Bruner, 1975; Bullowa, 1979; Halliday, 1975; Hubley & Trevarthen, 1979; Sugarman, 1984; Wilkes, 1981).

The information compiled on the nonsymbolic, prelanguage stage is particularly relevant to the study of children with deaf-blindness since many of these children function at a developmental stage that is very similar to the prelinguistic level of nondisabled infants. Both children with dual sensory impairments and infants without disabilities functioning at this nonsymbolic level rely heavily on gestural, vocal, and tactile-related means to communicate their needs. Thus, the study of preverbal interactions between infant and caregiver can provide important information relevant to nonverbal communication facilitation for the child who is deaf-blind as well as for the normally developing child.

The following sections focus on the influence of the primary caregiver on the child's development of communication skills. The first addresses the sensitivity caregivers display in responding to the infant's visual, gestural, and vocal behaviors. The second examines the salient features of the caregiver's behavior that influence the development of early communication patterns.

Sensitivity to Early Infant Behaviors

Several authors view the influence of the primary caregiver during the nonsymbolic stage as vital for the infant's future communicative ability and progress (Bakeman & Adamson, 1984; McClowry & Guilford, 1981; Odom, 1983; Snow, 1984). The importance of caregiver/infant interactions for the infant's future communicative growth is aptly stated by Odom (1983), "From birth, survival depends on the ability to interact with other human beings in a reciprocal manner. During the early months of life, environmental effects are mediated through the social interactive relationship between the infant and its caregiver" (p. 215). Through a stable, nurturing relationship with the caregiver, infants develop a feeling of security in their new world. This contributes to the infant's confidence in exploring the environment. Out of this confidence, a firm base is established for future attempts at social interaction and communication exchanges.

Prior to using speech, a unique and considerable history of dialogue has evolved between the primary caregiver and infant. Newson (1977) states, "Babies and their regular caretakers do normally share a massive and continuous history of previous attempts at communication, in the course of which they have negotiated a flexible repertoire of specific gesture signals" (p. 53). Kaye (1979) describes this history that develops as if the mother has a bag of tricks that have worked effectively in the past. She constantly watches and listens for new developments from the infant to add to her bag. Clearly, caregivers provide a kind of scaffold for their infants in expanding the communicative bounds. In fact, caregivers seem predisposed to providing supportive frameworks and predictable routines, adjusting and adapting these so that the infant has the support and encouragement to develop communicatively (Adamson & Bakeman, 1984; Newson, 1977; Snow, 1984; Zinobar & Martlew, 1985). Caregivers generally accommodate communicative deficiencies that infants have initially, placing them in situations where the skills they lack are performed for them until the infant has learned to play the role of a communicative partner (Kaye, 1982). As caregiver and infant mutually participate in communicative exchanges, they develop a unique shared knowledge of one another that enables them to predict further positive interactions.

The caregiver's ability to predict and interpret nonsymbolic signals provides infants with the feeling that their behaviors do elicit a predictable social response from the caregiver. In turn, this success in responding appropriately to the infant's nonsymbolic signals engenders a feeling of competence in the caregiver. The combination of these two aspects of the interaction (the child's effective signals and the caregiver's relevant responses) results in frequent, mutually satisfying interactions (Clark & Seifer, 1983; Goldberg, 1977). Further, the responsiveness of the caregiver can be related directly to the infant's success or failure in learning to communicate (Carlson & Bricker, 1982; Hanzlik & Stevenson, 1986).

A few studies have focused on the absence of caregiver sensitivity. Research has demonstrated the effects of maternal gaze aversion and maternal unresponsiveness on nondisabled infants (Field, 1983; Stern, 1974; Tronick, Als, Adamson, Wise, & Brazelton, 1978). In most cases, when caregivers were asked to look away from their infants or exhibit an expressionless face, the infant at first became inquisitive and tried to gain the caregiver's attention using vocalizations and gestures. Then the infant turned away from the caregiver and eventually turned to some other activity. This suggests that when infants do not receive reinforcement from their caregivers they learn not to rely on the caregiver to respond to their communicative attempts. This lack of maternal input and response leaves the infant virtually cut off from the close affinity found in a healthy caregiver-child relationship. Such an unsatisfying relationship puts the infant in a relatively isolated environment and at an obvious disadvantage in the

process of acquiring communication and language. Furthermore, it has been found that there is a great difference between children raised in an institution and children raised in close contact with their primary caregivers (Bowlby, 1951; Kelly, 1982). Children who have been raised in institutions generally function at lower developmental levels as compared to children who experienced a normal caregiver-child relationship (Spitz, 1945). This would suggest that a child who does not receive the sensitivity and contingent responses found in the typical relationship between primary caregiver and infant, does not have the same opportunities for developmental success.

Researchers have found that the communicative competency of the infant at the nonsymbolic level of communication is related directly to the reception of contingent caregiver responses (Hanzlik & Stevenson, 1986; Lamb & Easterbrooks, 1981). If one of the persons in the dyad does not elicit reinforcing behavior that encourages a stable framework, the relationship is continually jeopardized. Both caregivers and infants must actively contribute to their interactive exchanges in order for them to work effectively.

Caregiver responsiveness to visual behaviors. In the study of nonsymbolic interactions, particular attention has been paid to the infant's visual responses and cues (Als, 1979; Capute, Palmer, Shapiro, Wachtel, & Accardo, 1981). Between the first and second month, the infant is able to scan faces (a visually complex package of stimuli) and fixate on the eyes (Odom, 1983; Stone, 1979). Parents find this early eye contact very appealing, and mutual gaze is considered a positive contribution for early social relationships (McClowry & Guilford, 1981). The caregivers' interpretations of their infant's smiles as indicating pleasure, and other facial expressions as being social in nature, foster a powerful bonding (Thelan, 1985). Aspects of infant behavior show that social smiling and eye contact have a profound effect on the development of the attachment between infant and caregiver (Mirenda, Donnellan, & Yoder, 1983).

Eye contact is a salient indication of communicative involvement and is the infant's frequent means of initiating communication. Several studies have observed that the mother is most likely to respond when the infant's gaze turns toward her (Brazelton, Koslowski, & Main, 1974; Clark & Seifer, 1983; Hubley & Trevarthen, 1979). At 4 months, infants learn to look toward the focus of their mother's attention. "Likewise, he learns to direct her gaze by fixating his visual focus on subjects to which she subsequently attends. Mothers often interpret their infant's interest by assigning meaning to the child's actions" (Bricker & Carlson, 1980, p. 40). By assuming an intuitive interpretation of the infant's facial expressions, the mother or caregiver facilitates communication within the dyad.

Similarly, early smiling of infants is often spontaneous with no apparent cause, but the caregiver responds as if there were intentionality (Collis & Schaffer, 1975; Newson, 1979; Snow, 1984). By the third month of life the infant's smiling has become social, demonstrating responsiveness to faces (Hubley & Trevarthen, 1979; Odom, 1983; Stern, 1981). As demonstrated by eye gaze and smiling, early communicative behavior includes both visual discriminatory skills of infants and the affective interpretation by adults of what the visual signals may represent.

Caregiver responsiveness to gestural behaviors. Gestural behavior also influences early communicative exchanges. The child who is nonsymbolic may use a variety of gestures: reaching, clinging, holding, pulling, pointing, head shaking, waving, or motioning in order to convey a message, seek approval, receive assistance, or to gain proximity to the caregiver (Brooks-Gunn & Lewis, 1984; Newson, Gregory, & Hartley, 1985; Sugarman, 1984). Several authors affirm that the infant's gestural communication precedes speech (Brooks-Gunn & Lewis, 1984; Newson, 1977; Snow, 1984), and that

gestures are more meaningful than speech to the nonsymbolic child (Barten, 1979; Murphy & Messer, 1977; Wilkes, 1981). Snow (1984) observes that the infant's progress in communicative competence is reflected in the use of gestures. Infants are capable of using commonly understood gestures in the first few weeks of life (Newson et al., 1985). Initially, infants display whatever movements or gestures are available to them, using limited signals to respond to different stimuli. For example, infants may indicate a refusal to cooperate or a rejection of social interactions by turning their head away. Later, they develop a wider array of expressions that are more clearly directed to the specific context (Zinobar & Martlew, 1985). This is seen clearly in the culmination of development at the end of the first year with the start of intentional communication through gestures such as reaching, pointing, and offering.

Infant gestures have been shown to influence the behavior of caregivers (Masur, 1981). The caregiver can be credited with capitalizing on the infant's behavior, building on those actions to initiate communication (Newson, 1977). In fact, the uniqueness of the caregiver's sensitivity to the infant's gestures has led some researchers to study specifically the appearance of synchronization of head movements of infants and caregivers (Beebe, Jaffe, Feldstein, Mays, & Alson, 1985; Peery, 1980; Stern, 1971). Others have found a simultaneous coordination between adult vocalizations and the arm or leg movements of the child (Kato et al., 1983). This unique capacity to match each other's timing and duration of behavior suggests that an intuitive rapport exists within the dyad. The ability of the caregiver to interpret and respond accurately to the gestural behaviors of the infant is essential for effective communication. Caregivers continually structure the nonsymbolic communication setting in such a way as to build on whatever behaviors the infant spontaneously brings to the situation (Adamson & Bakeman, 1984; Newson, 1977; Snow, 1984).

An example of the caregiver responding and building upon the gestural behaviors of the child can be illustrated by discussing the commonly addressed gestural form of pointing. Of the many gestural forms used by infants in early communicative development, pointing has received considerable attention (Barten, 1979; Lock, 1978; Masur, 1981; Murphy & Messer, 1977). Murphy and Messer hypothesize that the infant's ability to point actually develops out of the ability to reach, which is present at 1 week after birth. Some arm extensions that have been labeled "reaching" may actually be attempts to control the behavior of an adult (Bower, 1974). In a game context involving the exchange of objects, the reaching gesture appears not only to get the object, but eventually to produce a change in the caregiver's behavior. When the infant reaches for an unattainable object, the adult converts the meaning of the gesture into a specific communicative intent (i.e., "I want," "Look," "What's that?").

Children use the pointing gesture as the first display of a symbolic action, demonstrating the ability to make reference to something in the world outside themselves (Stillman & Battle, 1986). This gesture combined with eye contact relates to the emergence of intentionality and corresponds to a further development of cognitive and sensorimotor skills (Mundy, Seibert, & Hogan, 1984). Intentional gestures have origins in earlier forms of behavior and many gestures appear before an age when they seem appropriate or necessary (i.e., pointing the index finger at 1 month of age). The caregiver plays an essential role in interpreting and conventionalizing the infant's gestures. The ability to discern the infant's signals, and readily interpret a gestural expression as if it had specific meaning, aids each communicative exchange.

Currently, some researchers are broadening the conception of gestures beyond the usual focus of the pointing gesture. There is a growing interest in recognizing the importance of a larger spectrum of gestures that incorporates many of the infant's

nonsymbolic movements and actions. This larger concept is recognized by Zinobar and Martlew (1985) who define a gesture as a signal of formal movement that functions primarily to communicate a consistently interpreted meaning to another person. Within this definition, Zinobar and Martlew describe four separate functions of gestures. These include (a) instrumental gestures that serve primarily to change the behavior of another as in requesting a service (i.e., a reaching gesture or clenching and unclenching the fist to indicate the desire for something); (b) expressive gestures that display positive or negative feelings (i.e., arm flapping when receiving a treat); (c) enactive gestures that are generally acquired through imitation or modeling of adult behavior, that often occur in the context of pretend play and may characterize the actions of people or events; and (d) deictic gestures that focus mutual attention on an object or activity (i.e., pointing).

Instrumental and expressive gestures are responded to by the caregiver even though a direct model for these types of gestures is not provided. (Caregivers do not clench and unclench their fists to request something or flap their arms when delighted.) On the other hand, deictic and enactive gestures are modeled and encouraged by the caregiver. As the infant matures, deictic and enactive behaviors become prominent in their interactions. Clearly, gestures encompass a wide range of actions and play an important role in the development of communication between mother and infant. By the time children begin to acquire language, they have already experienced several modes of effective nonsymbolic communication with people in the environment.

Caregiver responsiveness to vocalizations. The importance of infant vocalization as a form of nonsymbolic communication exchanges has been documented by several authors (Als, 1979; Brooks-Gunn & Lewis, 1984; Capute et al., 1981). Wilkes (1981) presents a description of three preverbal stages in the development of language and lists the types of vocalizations used in each stage. Her intent was to assist parents of children with hearing impairments in assessing progress and in recognizing what to expect and encourage within the varied continuum of early vocalizations.

1. Undifferentiated vocalization: The infant listens mainly to patterns and intonations of adult speech, understanding little. By 3 months of age cries, fretting, grunts, sighs, coos, burps, and gurgles may all be indicative of communicative intent. The infant is learning by means of adult reinforcement that "noises pay off . . . vocalizations produce results" (p. 395).
2. Social vocalization: In this stage the infant experiments with various sounds by vocalizing in recognition, to gain attention, and to express displeasure or satisfaction. The child develops an awareness that "different vocalizations produce different results" (p. 396).
3. Babbling: The infant consciously imitates sounds and sound combinations, babbling in a monologue at times. There is extensive vocalizing with a wider use of differentiated syllables. The infant understands very little, however, unless reinforced by adults. "The key concept for this stage is that vocalization is fun (socially reinforcing)" (p. 396).

Caregivers facilitate these nonsymbolic exchanges by treating the infant's vocalizations as if they were parts of a meaningful conversation. Of all vocalizations perhaps the most controlling behavior is crying, as it tends to immediately elicit an adult response (McClowry & Guilford, 1981; Odom, 1983). From birth, crying may be used as a survival mechanism for the child in order to maintain proximity to adults (Als, 1979). For instance, caregivers often respond to fussing and crying by holding the

infant close, which usually reduces the behavior. Research has suggested that mothers who were most responsive to their infant's cries during the first few months had infants who cried the least. In addition these same infants had increased communicative behavior at 9 to 12 months (Appleton et al., 1975; Bell & Ainsworth, 1972; Odom, 1983). Shevin (1979) also studied the effect of infant crying on adults. To young institutionalized infant, loud crying may be the most effective way of controlling the behavior of people around them. The caregiver's responsiveness to all vocalizations, including crying, is essential for the development of communication (Walker, Levine, & Grasse, 1982).

Salient Features of Caregiver Behaviors

As previously discussed, the engagement of the infant in nonsymbolic interactions is most successful if the adult utilizes eye contact, clearly defined gestures with relevant vocalizations, and is able to interpret the gestural, visual, and vocal cues of the infant (Clark & Seifer, 1983; Newson, 1977; Pawlby, 1977; Walker et al., 1982). How the caregiver responds, initiates, and expands on the infant's cues shapes the foundation for the development of later language acquisition (Fogel, 1977; Hayes et al., 1984). Newson (1977) describes how the caregiver and infant are at two very different levels of competence. The caregiver must dramatize and exaggerate to maintain the infant's attention. It may appear that caregivers consistently attempt to maintain a conversation with a conversationally inadequate partner (Snow, 1977) by using their own gestures, vocalizations, and eye contact. For learning to be effective, the caregiver arranges the environment to create a just-manageable situation for the child's skills as well as promoting further skill acquisition (Bricker & Carlson, 1980; Cole & St. Clair-Stokes, 1984b).

Visual behavior of caregiver. Several studies note that the mother's gaze behavior is one of the most salient features in early mother-infant interactions (Bakeman & Brown, 1977; Hayes et al., 1984; Stern, 1974). A synthesis of these three studies indicates that the mother's gaze usually lasted four times longer than the infant's, and that during the research sessions the mother looked at her infant 75 to 90% of the time. Consequently, when an infant looks at the mother, eye contact will usually be established (Schaffer, Collis, & Parsons, 1977). The importance of reciprocal eye contact is aptly described by Stern (1977) as a "magic moment" for mother and infant and may serve the function of bonding. This eye contact can serve a variety of functions: the signal of an intent to communicate, the establishment and recognition of the relationship, the integration of feedback, the collection of information, and the regulation of conversational speech (Hayes et al., 1984).

In addition to utilizing consistent eye contact, responsive caregivers use very animated facial expressions, widened eyes, big smiles, and head nodding or bobbing to indicate acknowledgement of the infant's behavior or to gain attention for further communication (Als, 1979; Clark & Seifer, 1983). Most infants at 3 months of age find the faces of their caregivers intensely interesting and are drawn to these faces that hold an infinite variety of expressions. "[Studies] show that the infant's attentional preferences are well-fitted, 'pre adapted' to just the kind of stimulation normally provided by parents' faces" (Kaye, 1982, p. 47). Both members of the dyad profit by the use of these emotional facial expressions that seem to generate a mutually positive and compelling interchange (Newson et al., 1985). Increasingly complex messages can be passed in the facial expressions between caregiver and infant as the infant learns that these faces are responsive and do convey meaning (Newson, 1984). The caregiver's obvious enjoyment of the infant coupled with sensitivity to the infant's readiness to interact are significant factors in establishing smooth interactions.

Gestural behavior of caregiver. The adult's use of gestures is important to the infant's understanding of communicative exchanges with social partners (Murphy & Messer, 1977). To convey different messages and to attract or hold their infant's attention, caregivers use gestural cues such as tapping, clicking their fingers, pointing, touching, patting the head or back, holding, and rubbing the infant (Adamson & Bakeman, 1984; Brooks-Gunn & Lewis, 1984). Newson (1977) observed that many gestures have particular meaning only in the context of the moment. The timing of the gesture and its contextual significance is more crucial for the infant's comprehension than the physical form of the signal itself. (Specific examples of the importance of timing are discussed in the forthcoming section.) Caregivers adapt their gestures in accordance with their infant's focus of attention, altering their actions and adjusting to answer the infant's response (Adamson & Bakeman, 1984). Often the caregiver's gestural behavior is exaggerated dramatically to attract attention and is carefully timed to correspond with the infant's ongoing activity (Newson, 1985). Macnamara (1977) found that if infants understand a verbal direction they respond to it, but the infant can be misled by a look or gesture. This would signify that the adult's use of gestures during interactions is more meaningful for infants than the use of unknown words.

Vocalizations of caregiver. In addition to the use of gestural and visual cues in exchanges between infant and caregiver, a special form of speech known as "motherese" is also used. It has been noted that adults adjust their language in a uniquely stylized way when talking to infants (Als, 1979; Beebe et al., 1985; Koenig & Mervis, 1984). Motherese is characterized by the use of short, grammatically simple utterances (Snow, 1984); a high-pitched voice (Odom, 1983); occasional whispering and special intonations, including a rising terminal intonation (Clark & Seifer, 1983; Tronick, 1980). Mothers' speech also involves a predictable pattern of vocalization that is rhythmic, repetitive, and slower with pauses before and after important words, which helps to sustain the infant's attention (Clark & Seifer, 1983; Tronick, 1980). In addition, mothers typically use exaggerated and rapidly changing facial expressions, a variety of nonspeech noises, and close physical contact, usually ensuring face-to-face interaction (Kent-Udolf, 1984). Caregivers tend to assess their communicative input and time it so that infants will receive the message when they are most able to understand it. In other words, they simplify their utterances to a point where the infant is just able to understand, so that the caregiver's language input is one step ahead of the child's productive abilities (Bates et al., 1982).

Brown (1977) suggested that the basic components of motherese or "baby talk" could be divided into two groups: (a) Communicative Clarity and (b) Affection/Nurturance. Communicative clarity refers to simplifying the forms used in communicating with an infant, making adult speech easier to comprehend. Affection/nurturance features the use of affectionate terms or a recognizable warmth in the vocal intonation that expresses a particular kind of affinity or closeness between adult and infant (Levin, Snow, & Lee, 1984). Caregivers' desire to make themselves understood and to express affection are both basic elements in this special form of speech (Chapman, 1982). The caregiver's exaggerated warmth of intonation, usually loaded with feeling, furnishes the infant with an additional coherence to the message that would not exist otherwise (Newson et al., 1985). It appears that caregivers continually fine-tune their speech in order to match the child's comprehension and developing linguistic skills (Brooks-Gunn & Lewis, 1984).

Besides receiving a special language, infants demonstrate a capacity to discern special aspects of vocalizations (Schiefelbusch, 1984). Caregivers, meanwhile, adapt their input to the infant; based on the infant's ability to discern voice features and intonations (Ferguson, 1964; Stern & Wasserman, 1979). Kaplan and Kaplan (1971) found that infants at 2 to 4 months of age responded differentially to three important contrasts

of voice feature: angry versus friendly, familiar versus unfamiliar, and male versus female. McClean and Snyder-McLean (1977) observed discriminative responding during the early infant period to (a) extra- and paralinguistic voice features, (b) intonation contours, and (c) familiar phonemic intonation patterns. The results of these studies indicate that the infant is responding to and synthesizing various information from vocal stimuli long before words have any meaning. The infant's discriminative abilities match with the unique characteristics of motherese utilizing both the infant's natural interest to discern and discriminate and the mother's natural propensity to use a special speech form.

The mother's repetitions and expansions of the infant's utterances based on the ongoing activity, situation, or infant's focus of attention play an important role in the acquisition of early communicative skills (Walker et al., 1982). Maternal speech is largely controlled by the concrete perceptual world of the young child. A large percentage (65-75%) of the mother's utterances to a 6-month old refers to the infant's immediate surroundings (Collis & Schaffer, 1975; Snow, 1984). Modifications found in maternal speech can be seen as adaptations to the infant's capabilities and preferences.

Components of Early Interactional Processes with Infants

As discussed in the previous section, a complex, regulatory feedback system between the caregiver and infant exists at birth. The caregiver's auditory, gestural, and visual signals provide the infant with meaning and feedback about the social and physical world. The newborn's behaviors facilitate predictable responses from the caregiver and provide the opportunity to develop patterns of negotiation, expansion, and differentiation (Als, 1979). Early nonsymbolic development is influenced by the context of social interactions (Bricker & Carlson, 1981; Cole & St. Clair Stokes, 1984a, 1984b; Lamb, Bell, & Borts, 1982; McCollum, 1984) as they provide "the major setting in which the infant practices and learns social, cognitive and communication skills" (McCollum, 1984, p. 301). Furthermore, the infant's orientation to relevant visual, auditory, and tactile signals contributes to sustained interest in objects, persons, or situations and may develop further communicative skills.

Even before infants intentionally communicate, caregivers attempt to interact and search for communicative responses in the infant's behaviors (Snow, 1984). Caregivers look at clues within the immediate context to decode the intent of their infant's cries. For example, the adult may monitor the infant's behavior, interpret the infant as having a certain intention, and may partially or completely fulfill that intention. These extremely responsive adult behaviors strengthen the relationship and promote the involvement of both members in social interchange (Coggins & Sandall, 1983; Kaye, 1982). Warm, socially responsive caregiver behavior is important, facilitating both attachment and cognitive development (Bates, Olson, Pettit, & Bayles, 1982). Maternal responsiveness has been related to the development of infant attentional and cognitive abilities (Brinker & Lewis, 1982). The infant comes to expect the caregiver to be responsive to signals (Lamb et al., 1982) and mutual responsiveness develops within the dyad (Elliott, 1984; Rogow, 1984).

Early interactions between caregivers and infants have been described as conversational or conversation-like (Bakeman & Brown, 1977; Tronick, 1981; Walker et al., 1982). During these nonsymbolic exchanges, the infant acquires the turn-taking rules that underly conversation, (i.e., how to initiate, maintain, interrupt, and terminate vocal exchanges). Caregivers continually provide the infant with clues about conventionally appropriate devices for signalling a turn in the conversation (Kuczaj, 1986). When in synchrony, the caregiver and infant are observed to time their

vocalizations to the vocal behavior of each other (Calculator, 1984). These early interchanges, however, are primarily initiated and maintained by the caregiver, the more sophisticated partner in the interaction (Bakeman & Brown, 1977; Elliott, 1984; Fogel, 1981; Hayes et al., 1984; Hubley & Trevarthen, 1979; Walker, 1982). Caregivers continually monitor their infant's activity (Clark & Seifer, 1983; Hayes, 1984; Hayes et al., 1984; Schaffer, 1977) and are attentive to their signals. For example, they learn to understand the meanings of their infant's signals and how to respond (Lamb et al., 1982; Newson, 1979). Caregivers are "continually learning how to structure the communication situation more effectively so as to capitalize on whatever the infant himself spontaneously brings to it" (Newson, 1977, p. 59).

As noted previously, infants are equipped with a repertoire of behaviors that function as communicative signals to the caregiver. These signaling behaviors include smiles, cries, facial expressions, eye contact, gestures, and vocalizations. Caregivers also respond to their young infant's behaviors as if they were intentional attempts to communicate (Fafouti-Milenkovic & Uzgiris, 1979; Hayes et al., 1984; Hopkins, 1983; McClowry & Guilford, 1981). At the same time, caregivers maintain their infant's attention through exaggerated rhythmic speech, ritualized play, animated facial expression, consistent eye contact, and gestures (including patting, touching, holding, pointing, and tapping). Patterns of reciprocity develop between caregivers and infants, occurring repeatedly throughout the day within natural routines. Through these repeated experiences the infant learns to be active and becomes more proficient in assuming a role within the interchanges (Newson, 1977). The infant begins to actively initiate, maintain, or terminate communicative exchanges (Lamb et al., 1982).

Communicative Opportunities During Daily Activities

A fixed and ordered set of actions develops between caregiver and infant during their daily ritual routines (Sugarman, 1984). A considerable history of involvement takes place between infant and caregiver in the first year of life. This two-way communication occurs as an indirect consequence of the care and protection necessary to keep an infant alive and well (Newson, 1977). The daily ritualized activities such as diapering, feeding, and bathing provide many natural settings for interactive exchanges to evolve between infant and caregiver. The routines that develop out of these daily activities provide an excellent opportunity for the caregiver to teach communication skills indirectly in a relaxed and emotionally supportive environment.

Daily routines. The social routines between caregiver and infant utilize several components that aid the nonsymbolic exchange. Social routines are clear and repetitive with a well-defined beginning and ending, providing the infant with an understanding of reciprocal roles and turn taking (Shea & Mount, 1982). Roles for each communicative partner, with opportunities for reciprocity, mutual involvement, and shared attention are all an inherent part of daily routines (Rogow, 1984). An understanding of the mechanics of shared attention and turn taking develops as part of the process of prelinguistic communicative development, providing a foundation for the subsequent acquisition of language (Mundy, Seibert, & Hogan, 1985).

Within the familiar framework of daily routines, both caregiver and infant are often attending to the same object or event. Referring to this as joint referencing, Bruner (1983) traced the development of this process back to approximately 3 months of age when the infant follows the mother's gaze, resulting in mutual attention to the same object. Several aspects of preverbal communication (e.g., giving, showing, pointing, and requesting) exercise the social function of shared attention and joint reference and are used frequently because objects often provide a focus to which mothers and infants

attend (Yoder & Farran, 1986). During these joint referencing exchanges, the child's attention can be directed more easily toward the particular objects or events referred to in the adult's speech (Bates et al., 1982). Eventually, the infant will use this shared attention to an object, combined with reaching, grasping, and vocalizing to request the object. This is an important part of the acquisition of language because the communication occurs in the context of a joint enterprise in which the infant develops a need to signal in order to request something (Bruner, 1977). Through joint activities, the child comes to understand maternal gestures (e.g., pointing, direction of gaze toward referents) and intonation patterns (e.g., the tone of voice used in requests for action as opposed to casual comments or commands to stop action).

The natural occurrence of daily routines also establishes a structure that enables the infant to anticipate a sequence of events. This opportunity to predict familiar events is vital to the infant's understanding of rules, structures, and other innate components of communication and language learning (Newson et al., 1985). The infant is encouraged to develop gestural and vocal expressions that will function as effective social signals. As infants become increasingly aware of the social world, they learn to recognize their role in the context of familiar events and to anticipate the next occurrence (Rogow, 1982; Stillman & Battle, 1986). In addition, the more children engage in reciprocal interactions with a primary caregiver, the more an intuitive understanding for the other person develops (Newson, 1984). The mutual use of a few shared understandings establishes a basis for further comprehension, continually expanding the infant's cognitive consciousness and communicative awareness.

Games. A large percentage of daily routines occur within a playful setting. The relaxed play situation is helpful in creating a learning environment, free from pressure, for acquiring communication skills. In fact, the ambience of play is central to providing a setting for tension-free learning (Bruner, 1977). In play the caregiver makes use of the child's attention on the ongoing activity to facilitate or initiate an exchange. This encourages a playful spirit because the source of their communicative content is the child's activity, unlike a strict teaching situation where the caregiver's objective is the focus (Walker et al., 1982). The occurrence of games throughout the day provides supportive learning situations for the infant since the games involve, by their very nature, a playful, relaxed environment. Games are compelling to infants because of their fun-filled spontaneity that delights and pleases, and attracts the infants' attention. By participating in games, the infant gains experience both in comprehending information and in relaying and expressing information (Schiefelbusch, 1984).

Social games in infancy possess several distinct features: (a) mutual involvement, (b) turn taking, (c) a clearly repetitive structure, and (d) a small number of elements and semantic relationships (Goldman & Ross, 1978; Hodapp & Goldfield, 1983; Hodapp, Goldfield, & Boyatzis, 1984; Ross & Kay, 1979; Walker et al., 1982). Mutual involvement can be evidenced by simultaneous attention and interest in the ongoing activity of the dyad. This has been observed in infants, 2 to 4 months old, during facial game play (Brazelton et al., 1974). It appears to be the prerequisite to social interactions and a necessary condition out of which other actions may proceed (Hodapp & Goldfield, 1983).

The second component, turn taking, allows children to clearly comprehend their role in the interaction. This continuous exchange of turns establishes the timing and sequence of the game, and the need to pause in anticipation of the partner's turn. During the progression of a game, there are specific times for appropriate vocalizations that serve as markers during their interactions (Walker et al., 1982). In time, the reciprocal nature of turn taking may evolve beyond the adult leading the interaction into a reversible-role game. Through repeated imitative exchanges, the child may assume

the adult's original role (Stillman & Battle, 1986), and the adult accommodates by taking on the child's role.

The third component, a clear repetitive structure, enables the infant to become immediately familiar and comfortable with the game context. Most games include an easily recognized sequence that occurs repetitively. The infant's use of repetition has been observed as a natural phenomena in nonsocial learning situations when they are exploring objects in their environment (Hodapp & Goldfield, 1983). Infants may experiment persistently with different aspects of their environment, repeatedly handling and touching objects in a specific manner and babbling recurrently. The fact that repetition is an integral part of games capitalizes on the infant's natural tendency to learn through continual practice.

The last feature of games, a small number of elements and semantic relationships, aids in simplifying the structure and cycle of the game. The lack of complexity and extensive vocalizations allows the infant to comprehend the rules and sequence of the game easily, without a sophisticated foundation in language. All of these components (mutual involvement, turn taking, a clear repetitive structure, and a small number of semantic relationships) facilitate the infant's acquisition of communication and language. In addition, the playful atmosphere found in the game setting lends warmth and a relaxed mood to the "disguised" teaching situation. Caregivers wisely use these natural teaching opportunities as they arise within play and daily activities.

Skills promoted by games. Researchers agree that games provide specialized contexts for teaching social and cognitive skills, and do seem to promote communication and language development (Field, 1983; Rogow, 1984; Ross & Kay, 1979). In one study (Hodapp et al., 1984) infants were observed to learn certain skills faster in the context of a game than in a nongame setting. For example, in a game of roll-the-ball, infants were able to return the ball to their caregivers 1.6 months earlier than they were able to give back other objects when the exchange was not part of a game context. When caregivers held out their hands in encouragement, the infant also returned the ball more often. The caregiver's clearly understood gesture combined with the familiar, repetitive structure of the game increased the child's attention and interest in returning the ball and continuing the game.

Further, the exciting, emotional nature of most games easily attracts and holds the infant's attention. Caregivers display their involvement in the game by adding a quality of excitement to their vocalizations and gestures. This compelling quality thrills infants who may reciprocate with a demonstration of their own jubilation. This environment, where the infant is fully involved in interchanges, is a prime setting for learning skills related to social and communicative interactions.

Many skills can be learned within the context of games because they establish a simple structure that provides an opportunity to promote social awareness and other communicative skills (Bruner, 1975; Sachs, 1984; Stillman & Battle, 1986; Sugarman, 1984; Walker et al., 1982). Bruner (1983) emphasized the role of games in promoting interactive competence due to the clearly standardized format, which includes sharply defined roles that can eventually be reversed. Games provide a supportive system for nonsymbolic interactions to occur successfully, increasing the infants' awareness of other people and shaping their understanding of reciprocal roles (Rogow, 1984). One example of this is found in the peekaboo game where the infant's awareness of the caregiver is promoted. In the peekaboo game the infant's attention is immediately drawn to the person hiding under a blanket. When the person uncovers themselves suddenly and then hides again, the infant is surprised and delighted. In a short time, the infant may come

to predict the routine of this game when it begins again. Likewise, in most games, after a few repetitions the infant begins to anticipate what will occur next. At this point the infant may make some move as in a request to continue the game. Due to this reciprocal and repetitive nature of games, infants are quick to discover not only their role in the game but also to predict their caregiver's next move. Once an infant can anticipate an adult's actions the expression of awareness and comprehension occurs (Bullowa, 1979).

Through repeated experiences during games, the gestures the infant makes in response to the adult become intentional (Newson et al., 1985; Ratner & Bruner, 1978). Gradually, gestures are performed by the infant to achieve a specific goal. These signals arise spontaneously in the context of an interactive game and become specific to the ongoing activity (Stillman & Battle, 1986). At first the infant's intentional signals are used only to continue an ongoing game. Later, they become aware of their ability to initiate a game by imitating the role they see the caregiver perform (Ross & Kay, 1980). Eventually, infants realize their ability to change or manipulate the responses of the caregiver. When the daily ritual of games is well established, both caregiver and child can expand and alter the rules and cycles of their games (Ratner & Bruner, 1978). Teasing, choosing not to perform, withholding an object, or delaying the appropriate response all comprise new elements of a game context that clearly demonstrate the infant's control over the course of events (Newson et al., 1985).

Caregivers role in games and daily routines. Caregivers use several important features during games and daily routines that aid the infant's understanding of the communicative interchanges. Social games and routines are particularly useful in providing a setting where the caregiver can use adequate (maternal) scaffolding (Ross & Kay, 1980). This includes stage-setting and attention-getting behavior, some of the prerequisites to social interaction (Hodapp & Goldfield, 1983; Hodapp et al., 1984). Caregivers may set the stage by removing any possible distractions and by placing the infant in front of them. The caregiver will use various vocalizations and gestural forms to gain or direct the infant's attention. They may also use the focus of the infant's immediate attention to build an appropriate learning situation. In fact, Walker et al. (1982) found that most maternal vocalizations in a play setting refer to the infant's focus of attention or current activity.

Through scaffolding, the caregiver is trying to elicit the most advanced behavior possible from the infant. At the same time the caregiver wants to keep the game or social exchange fun, interesting, and at a level that the infant can comprehend easily (Hodapp & Goldfield, 1983; Hodapp et al., 1984). A great advantage of games and other similar routines is that they can be elaborated and complicated to stay at, or just beyond, the child's level of competence (Snow, 1984). When learning a new game or skill, the caregiver may try to channel the infant's approximation of the expected response into its desired form. This may be achieved by providing appropriate clues that reinforce the infant's relevant behavior. The caregiver's sensitivity to the infant's needs allows provision of additional help when it is most needed. Hodapp et al., (1984) observed caregivers supplying this type of supportive behavior more frequently when the infant hesitated in the process of learning a new skill or game. Caregivers can transform what may appear to be random vocalizations and gestures into effective social signals. Adults bring added structure and meaning to the infant's world by responding in an appropriate and consistent manner to the infant's demonstrations.

Characteristics of Early Communicative Interactions

Early exchanges between caregivers and infants are important in establishing a dialogue-like structure within which the infant acquires communicative competence. The

acquisition of nonsymbolic dialogue is essential in the development of communication and language (Hayes, 1984). Thus, the caregiver's role offers many opportunities for social exchanges and provides the structure for early communicative interactions. Within early exchanges, caregivers respond to their infants with sensitivity, timing, contingency, and predictability. All are important components of early interactional processes.

Sensitivity. Caregivers attract their infant's attention and elicit responses from them in a variety of ways. The caregivers' sensitivity to their infant's behavior is an important component of satisfying interactions (Clark & Seifer, 1983). Caregiver-infant communication includes qualities that characterize typical exchanges including sensitivity to the infant's cues and signals and appropriate responsiveness. Caregivers demonstrate sensitivity to their infant's signals of readiness to communicate, typically the infant's direct gaze, gestures, or vocalizations. They ensure the infant a turn during interactions, and are "careful to wait until he or she is through responding" (Clark & Seifer, 1983, p. 70). In essence, sensitive caregivers are alert to the initiations of the child and adjust their responses according to the child's communicative input (Halliday & Leslie, 1986).

In a caregiver-infant protoconversation, both members of the dyad exhibit a remarkable degree of sensitivity to each other. As infants transcend their egocentrism and realize the existence of the social world and individual people, they become more attentive to their communicative partners. At 4 months of age, an infant is able to follow an adult's attention, and does so increasingly over time. The infant's natural interest in the caregiver combined with the caregiver's almost continual focus on the infant promotes mutual attention and sensitivity (Bruner, 1977; Fraiberg, 1977; Thelan, 1985). Two studies (Beebe et al., 1985; Jasnow, 1983) describe the concept of mutual influence found in the nonsymbolic conversation of caregiver and infant. Both members of the dyad were able to keep pace with and balance the duration of each other's vocal and kinesic (nonlinguistic body motions) behaviors. Also, both caregiver and infant may have compensated for the other's change in activity level. The more activity one partner displayed, the less active the other partner became. In this manner they tended to maintain a relatively constant level of activity. This seemingly unconscious faculty to perceive each other's focus of attention and activity level and to respond accordingly is a remarkable, salient aspect of the caregiver-infant dyad.

Timing. In the early interactional process, the timing of a vocalization or gesture is probably more important than the type of expression that is used (Lamb et al., 1982; Newson, 1977). Caregivers adapt their timing to the infant, synchronizing their responses to the infant's activity (Hayes, 1984). "The mother thus allows herself to be paced by the infant. She fills in the pauses between his response bursts, and to do so successfully she needs, of course, sensitivity and an exquisite sense of timing" (Schaffer, 1977, p. 12). Caregiver-infant interactions have been described as cyclical and rhythmical in nature (Brazelton et al., 1974), with each communicative partner influencing the other (Lamb et al., 1982). Synchrony exists even between the infant's visual attention and the mother's facial expressions. Their face-to-face interactions are characterized by a tendency of the caregiver to exhibit facial expressions when the baby is attentive and to "turn off" when the infant looks away (Kaye, 1982).

Caregivers learn to form patterns of cycles to fit the infant's attention and continually readjust their responses in order to maintain the interaction. The infant's periods of attention to the caregivers provide an obvious temporal frame for the caregivers to organize their behaviors and responses. By adjusting to the on-off cycles of the infant's attention, caregivers create a consistent, smooth sequence of exchanges, which the infant can begin to recognize, respond to, and anticipate. When caregivers

allow their behavior to be temporally organized by the infant's behavior, they are really assimilating the infant's cycles of attention and arousal. This is similar to adult conversations, where turns are taken between speaking and listening (Kaye, 1982).

Some studies have also documented the infant's capacity to perceive temporal changes in the caregiver's social patterns (Beebe et al., 1985; Dumaney, McKenzie, & Vurpillot, 1977; Stern, 1977). It has been noted that newborns are capable of discriminating intervals of extremely short duration observed in the surprisingly synchronous movements between neonate and adult speech (Condon & Sander, 1974; Dowd & Tronick, 1986). Stern and Gibbon (1979) suggested models of how infants may estimate the time intervals of the caregiver's speech and predict the onset of the next vocalization. At 2 months, they demonstrate an ability to discern a change of timing in the caregiver's behavior to within a half second. This sensitivity to the temporal patterns of speech is significant as it is a basic component of adult conversations. Researchers have found that adult speakers who match each other's timing patterns usually see each other as warmer and more enjoyable (Feldstein & Welkowitz, 1978). In the caregiver-infant nonsymbolic interchange, there exists a remarkable ability to sense each other's patterns of timing (Jasnow & Feldstein, 1986). Sensitivity toward the other partner in the dyad enables them to avoid actions that would interrupt the enjoyable flow of their nonsymbolic conversation.

It is interesting to note that Beebe et al., (1985) observed infants matching timing patterns of a complete stranger. This demonstrates an innate ability to match with someone (mutual influence) where strong emotional bonds do not exist. Apparently the infant uses social-perceptual abilities regardless of the degree of closeness that exists with the partner. The infant's early ability to sense these changes in timing patterns is relevant in the study of nonsymbolic and communicative interactions. At a surprisingly early age, infants are able to demonstrate the same discriminative qualities that are found in adult conversations.

Another important component of successful adult conversations found in infant nonsymbolic exchanges is the aspect of the switching pause. This is the occurrence of a joint pause just before the exchange of speaker-listener roles. Jasnow (1983) documented the matching of these switching pauses between caregivers and infants who were 9 months of age. When this pause occurs immediately prior to the exchange of roles, it provides a smooth transition for both partners. Well-timed pauses are an important aspect of smooth turn-taking skills since they provide a chance to absorb information and not interrupt the speaker (Rowland, 1984). The ability found in caregiver and infant to synchronize their dialogues heightens the feelings of warmth and trust, and increases their mutual understanding.

When the caregiver lacks aspects of sensitivity and timing, the infant may feel disoriented and, in a sense, abandoned. Studies have shown that infant insecurity can be linked to disjointed timing in interactions with their caregivers. Tronick (1980) found that caregivers who interrupted their infants, not allowing reciprocity, lost the interest of their infants. When the caregiver's response is well-timed and appropriate, the infant can enjoy these exchanges and will be encouraged to participate more in the interactional process. Carlson and Bricker (1982) recommend that the caregiver allow the infant enough time to orient and recognize the response. Otherwise "the infant may lose the opportunity to attend or respond to the caregiver" (p. 304). Timing of new behaviors can also help to maintain the infant's interest in the interchange (Clark & Seifer, 1983). Caregiver sensitivity and timing of responses in relationship to their infant are among the many significant ways in which caregivers are able to engage their infants in the interactional process.

Contingency and predictability. The infants' contingency awareness, or ability to recognize the caregiver's behavior as directly related to their own, is fundamental to most learning and is especially important in the formation of emotional attachments (Watson, Hayes, & Vietze, 1982). The interactions infants experience with caregivers provide many opportunities to learn social contingencies; that is, to learn that their behaviors have predictable outcomes (Carlson & Bricker, 1982). For instance, infants learn that crying and smiling elicit particular responses from their caregivers (Odom, 1983). Children between 8 to 12 months of age understand that certain actions bring consistent results. Examples of these demonstrations include reaching to gain a desired object, shaking their head "no" or pushing away to indicate refusal, or acting during a pause in a game to express an interest in continuing (Chapman, 1982). Caregivers, in turn, learn that their responses have a certain effect on the infant; for example, holding the infant usually quiets crying (Carlson & Bricker, 1982). Thus, both caregiver and infant participate in mutually contingent experiences (Carlson & Bricker, 1982) and learn to "anticipate and match his or her own interactive behaviors" to the other's (Walker, 1982, p. 221).

Caregivers are of special interest to their infants (Newson, 1979) because of their contingent responsiveness (Clark & Seifer, 1983; Odom, 1983). Infants search for contingencies (Carlson & Bricker, 1982; Coggins & Carpenter, 1981; Lewis & Goldberg, 1969; Simmons-Martin, 1981) just as caregivers search for intention in their infant's responses (Snow, 1984). Intentional communication becomes possible only when infants have differentiated themselves from others. At the earliest level, the infant responds with a variety of nonsymbolic actions to various internal states and to physical sensations from the environment. The infant's vocalizations and gestures may result in a responsive action from the caregiver, but there is little evidence that the infant is aware initially of this relationship (Stillman & Battle, 1986).

The first intentional acts are demonstrated by infants around 9 to 12 months of age with the use of some form of gesture or vocalization to indicate their desire for something (Chapman, 1982); squirming, fussing, crying, and reaching are all various forms of this first deliberate message. By performing these automatic behaviors, infants begin to realize that their actions have effects on others (Schaffer, 1977) enabling them to anticipate subsequent responses (Odom, 1983). In other words, infants learn to predict the effects of their own actions, which leads to more intentional communicative acts (Clark & Seifer, 1983; Walker, 1982). The infant learns to anticipate a response from the adult and then to act in order to elicit a response (Rogow, 1984). For example, if the adult imitates the infant after the infant coos, the infant learns that his or her cooing sounds will gain the adult's response. The caregiver elicits a continuous social interaction in a manner that enables the infant to perceive the initial vocalization (coo) as initiating the interaction. The infant is delighted by the adult's repetition of the vocalization and responds by imitating the adult's last coo sound. Extensive use of imitation and expansion of the child's behaviors provides the child with opportunities to lead and initiate interactions. Expanding on the child's imitations (i.e., doing more in movement, sound production, or gestural behaviors), provides further intrinsically interesting communication models for the child. Additionally, both imitation and expansion create a playful quality that reinforces the social aspects of the exchange (Mitnick, 1984). Continuous, satisfying responses from the caregiver clearly influence the infant's sense of a reliable and receptive world.

A lack of contingent feedback by either communicative partner could lead to disruptions in the interactional process (Carlson & Bricker, 1982). Several studies have shown that infants who do not experience contingent responsiveness tend to be more passive and less interactive (Ainsworth, Blehar, Waters, & Wall, 1978; Odom, 1983).

Conditions that facilitate the development of contingency awareness can promote significant progress with an infant whose development has been delayed (Watson et al., 1982). Contingent responding by the caregiver affects not only the development of communication, but also affects infants' cognitive, attentional, and motivational development (Brinker & Lewis, 1982; Carlson & Bricker, 1982; Hanson, 1982; Odom, 1983). When infants consistently experience responses to their actions, then their actions gain new meaning.

Beginning at around 9 months of age, the infant may not be satisfied with a general or nonspecific adult response. By this time, the infant may use a particular signal in order to produce a specific effect. Infants learn to expand their signals and to expect particular responses. As the infant's range of intentional behaviors increases and becomes more clear, control and influence in the relationship improve. In this way, the infant becomes a stronger member of the dyad (Newson et al., 1985). Infants learn that their intent to communicate a specific message can be successful and bring the desired results.

Caregivers and infants together form a partnership, each relaying and requesting meaningful feedback (Tronick & Adamson, 1980). The more readable and predictable the infant's signals, the more the adult can respond contingently. Both caregiver and infant respond mutually and consistently to signals that lead to a warm and synchronized exchange. Caregivers play an important role in the development of the young infant's communicative abilities. They do this in part by being sensitive to their infant's behaviors. Caregivers establish synchrony by adapting their timing to their infant's behaviors and providing contingent experiences from which infants learn that they can control their world.

Components of Nonsymbolic Interactional Processes Among Children with Deaf-Blindness

Some children with severe disabilities and accompanying sensory deficits may function at developmental levels similar to those of young infants. For example, their motor responses include many of the same reflexes and motor patterns observed in infancy, and most children with deaf-blindness do not use symbols or speech (Stillman & Battle, 1986). Instead, they function at a prelinguistic, nonsymbolic communicative level. There are, however, some differences between infants without disabilities and children with deaf-blindness in the development and use of visual and facial behaviors, and in vocal and other related expressive behavior. Visual deficits may result in lack of gaze behaviors and normal eye contact; visual behavior may also be influenced by reflexes and therefore, is not voluntarily controlled (Clark & Seifer, 1983; Langley, 1980; Mirenda et al., 1983). Smiling behaviors may be delayed in appearing (Brooks-Gunn & Lewis, 1982; Odom, 1983), and children with deaf-blindness may require different responses (e.g., tactile-kinesthetic contact) from the caregiver to elicit them (Langley, 1980; Walker & Kershman, 1981), or they may be lacking (Odom, 1983). "From birth, handicapped infants may lack the potent elicitors of social interaction (e.g., smiles, gazes) found in nonhandicapped infants" (Odom, 1983, p. 243).

These early gazing and smiling behaviors are important in early interactions. Their absence may disrupt the interactional process and thus, may affect the infant's development of communicative competence. Their importance is emphasized by Langley (1980): "The two most significant factors in the development of a meaningful communication system appear to be the establishment of reciprocal gaze patterns between infant and primary caregiver, and the infant's subsequent smiling behavior" (p. 33). Children who are blind and experience a physical disability have limited ability to orient

the movements of their head or body or to direct their gaze. This poses a major obstacle to communication (Rogow, 1984). Clearly, the interactional process is affected if similar behaviors fail to appear within the repertoire of the child with dual sensory impairments.

Characteristics of Atypical Communicative Development

Children with deaf-blindness may differ in terms of developing a sense of causality, appearing to be unaware that their behaviors have an impact. This results in fewer expressions and repetitions of vocalizations or other behaviors (Langley, 1980) and, consequently, fewer opportunities for caregiver responses. In their study of children with deaf-blindness, Walker and Kershman (1981) found that fewer vocalizations, less distress, more neutral affect, and less predictability were exhibited by the children with deaf-blindness when compared to infants without disabilities. They also found that children with deaf-blindness offered fewer opportunities for caregivers to engage in interactive sequences. As a result, caregivers experienced difficulty in initiating and maintaining communication with these infants. Signals from the child with deaf-blindness or other disabilities are often mixed or unclear; the caregiver is less able to read them (Clark & Seifer, 1983) and is less likely to respond to them appropriately. Odom (1983) observes that children or infants with disabilities may be less responsive to the caregiver, directly influencing how the caregiver behaves toward the infant or child. "Research suggests that the communicative difficulties experienced by mentally retarded children are not restricted to language but are also manifest in early forms during the prelinguistic phase of development" (Mundy et al., 1985, p. 59).

Sensitivity. Caregivers of infants and children with disabling conditions carry the responsibility of eliciting responses from their infants, as do caregivers of nondisabled infants. Caregivers of infants with disabilities, however, may have more difficulty reading their infants' unclear signals (Clark & Seifer, 1983; Odom, 1983), affecting their ability to be sensitive to their infants' behaviors and to time interactive responses. In their study of maternal adaptation in interactions with children with deaf-blindness (developmental ages of 1-20 months) Walker and Kershman (1981) referred to issues of caregiver sensitivity. They found that caregivers of children with deaf-blindness exhibited sensitivity to their infants' unique types of behaviors and "seem willing to treat any behavior as social interaction, a response which seems to be very adaptive in this situation" (p. 28). Unlike caregivers of infants without disabilities, who respond primarily to vocalizations, the caregivers of the children with deaf-blindness demonstrated their sensitivity by responding to movement as a primary communicative category. Moreover, it was apparent that they responded not only vocally but kinesthetically (e.g., swaying & rocking), as well.

Another example of maternal adaptation to infants with multiple disabilities is seen in the caregiver's increased directiveness (Stillman & Battle, 1986). It was observed (Bailey & Slee, 1984) that infants with multiple disabilities responded to directions as often as infants without disabilities. Therefore, by initiating directive prompts, caregivers may be adapting their style of interaction to promote maximum response. Caregivers of children with deaf-blindness, however, used tactile responses when interacting with their children (although to a lesser degree than vocal or kinesthetic) even though it was typically followed by child distress (Walker & Kershman, 1981). The investigators also found these caregivers rarely used visual behavior to attract or maintain attention, whereas their children used gaze more often, "indicating that it has potential as an avenue for maintaining contact" (p. #27). Caregivers of children with deaf-blindness displayed sensitivity to their children's behaviors in some areas but did not respond similarly in others.

Results of the Walker and Kershman (1981) study further indicated that the caregivers of children with deaf-blindness were more active and persistent than caregivers of infants without disabilities. In trying to obtain responses, the caregivers had difficulty synchronizing with their children's interactive rhythm. For instance, the investigators found that the caregivers of the children with deaf-blindness interpreted neutral affect or the do-nothing category of behavior as noninteractive and used it to initiate an interaction. On the other hand, the caregivers of the nondisabled infants interpreted the "do-nothing" category as a rest period and waited for their infants to display more communicative behaviors. Caregivers of children with deaf-blindness have to make many more adjustments to their children and "change their own familiar patterns to match the unfamiliar patterns of their babies" (Walker & Kershman, 1981, p. 24).

Timing. Timing of responses may pose some difficulty for caregivers of children with deaf-blindness. Caregivers may respond at the wrong time in their child's cycle or respond too quickly (Carlson & Bricker, 1982), especially since their children are "less responsive, less predictable, and generally less interactive" (Walker & Kershman, 1981, p. 17). Interactions between caregivers and children with deaf-blindness are more complex than interchanges within a typical dyad since, in this instance, the child seems to violate caregiver expectations of early interactional patterns.

Infants and children with deaf-blindness have been found to lack responsiveness and interactive rhythm, placing the burden of interaction on the caregiver. Caregivers of these children tend to engage in a lower number of interchanges and use more repetitions than caregivers of nondisabled infants, perhaps reflecting more "wait-time" for the child's response (Walker & Kershman, 1981). Child behaviors such as lack of responsiveness and lack of rhythm or cyclicity can affect caregiver responses. It seems that caregivers of children with deaf-blindness demonstrate sensitivity, however, by adapting to their child's atypical responses and behaviors. Accompanying these responses are caregiver uncertainties about how and when to respond within these interchanges.

Contingency and predictability. Contingency experiences play an important role in early interactional processes between caregivers and nondisabled infants. Infants learn that their nonsymbolic expressions have predictable outcomes. "The contingent feedback provided by the caregiver to the infant's signals thus seems to be instrumental in fostering the development of communication just as it increases the baby's ability to control the environment" (Carlson & Bricker, 1982, p. 301). Carlson and Bricker point out, though, that contingency relationships between caregivers and children with disabilities may be difficult to establish. Brinker & Lewis (1982, p. 7) suggest that infants with disabilities may be deprived of contingency experiences as the following occur:

- Medical involvement may decrease the opportunity for social interaction (Klaus & Kennel, 1976; Vietze et al., 1980).
- Parental attitudes and feelings may reduce the number of co-occurrences [or association of two events] that the parents provide (Bell, 1980; Broussard & Hartner, 1970).
- The limited response repertoire of some handicapped infants may make both social and object co-occurrences less likely (Brooks-Gunn & Lewis, 1979).
- The ability to detect and remember co-occurrences may be limited for some handicapped children (Detterman, 1979).

- A complex process of infant-environment transactions may progressively reduce the frequency of social co-occurrences.

These authors contend that the infant also plays an important role in the reduced number of contingent experiences. Caregivers' attempts at social contingencies may diminish as a result of the infant's own lack of contingency.

Brinker and Lewis (1982) also suggest that some variance in social contingencies may exist as a result of interactive differences. Interactions in which the infant with disabilities seeks to control or affect the caregiver's behavior may be limited and defined by the caregiver. Within these situations, only activities initiated by the caregiver might result in predictable caregiver responses. As a result, contingency experiences are confined to situations that the caregiver delineates. It thus appears that the infant is often placed in a passive role with few occasions to initiate communication. This may result in fewer social interactions and, therefore, in fewer opportunities to experience social contingencies. Thus, the opportunities for infants to learn that their actions have an effect on the environment are patently limited. The reduced experience of contingent interactions may have significant consequences not only for the infant's communicative development, but also for learning, motivation, and affective and cognitive development. Snow (1984) stresses the importance of providing contingent experiences for the child with disabilities: "He may be able to develop language normally only in an optimum social environment, one with constant access to adult caretakers who are always able and willing to engage in contingent social interaction" (p. 100). Accordingly, the caregiver occupies an important role in providing contingent experiences within the early interactional process. (Refer to Schweigert, this volume.)

When a child has multiple disabilities including sensory impairments, the development of the interactional process is affected profoundly. Children who function at the preintentional communicative level of young infants need to experience the same synchronous and predictable relationship with their primary caregiver as infants without disabilities. Children with disabilities, however, may not be giving their caregivers readable signals (Clark & Seifer, 1983; Odom, 1983) and are not as predictable in their responses as the typical nonsymbolic infant (Walker & Kershman, 1981; Walker et al., 1982). In addition, caregivers of children with deaf-blindness experience more disruptions and uncertainties within the interactional process. Research with children who have mental retardation indicates that cognitive deficits contribute to impairments in the child's use of nonsymbolic communication skills such as referential eye contact, pointing, and showing (Mundy et al., 1985). This is particularly important because caregivers generally establish mutual attention by capitalizing on the infant's focus of attention. Yoder and Farran (1986) observed that atypical infants interacting with caregivers frequently interrupted joint attention with a reflex pattern or unfocused gaze. Thus, atypical infants may engage in behaviors involuntarily that make sustained attention to an object with their caregiver difficult.

Deficits in the infant's display of joint attention with the caregiver may lead to reduced opportunities for the dyad to experience shared exchanges. Therefore, caregivers may not come to perceive their child as a partner in social interactions to the same extent as caregivers of children without disabilities. This negative perception may be an important contributing factor in the development of a caregiver interactional style that actually decreases the child's opportunity to receive contingent responses. In fact, the interactional process might not contain contingent responsiveness for either member of the dyad. Rather, the caregiver assumes responsibility for initiating and controlling interchanges (Bakeman & Brown, 1980; Brinker & Lewis, 1982; Brooks-Gunn & Lewis, 1984; Lamb et al., 1982), without the guidance of typical infant signals and cues.

Consequently, the potential exists for asynchronous interchanges and disruption of the interactional process.

Caregivers of nonsymbolic children with deaf-blindness assume a crucial role in the child's development of communicative abilities. They are sensitive to their child's atypical responses and they try to time their own responses to the unfamiliar and unresponsive interactive patterns of their child. Contingent interactions may be difficult for the caregiver to establish as a result of less predictable responses of the child as well as the influence of disabling conditions on the interactional process. It is apparent that interchanges between caregivers and children with deaf-blindness reflect the same issues of sensitivity, timing, and contingency as interchanges between caregivers and nondisabled infants.

Caregiver Interactional Patterns with Children Displaying Disabling Conditions

There are differences in interactional patterns of caregivers and infants with disabilities and infants without disabilities (Cardosa-Martins & Mervis, 1985; Carlson & Bricker, 1982; Crnic, Ragozin, Greenberg, Robinson, & Basham, 1983; Field, 1979; Kogan, 1980; Odom, 1983; Walker et al., 1982; Walker & Kershman, 1981). These discrepancies usually are viewed as deficits reflecting the impingement of the disabling conditions on caregiver behaviors and on the overall interactional process. Some researchers have suggested that these interactional patterns may be adaptive and should not necessarily be viewed as deficient (Coggins & Sandall, 1983; Hanson, 1982; Walker, 1982). Warfo (1984) synthesizes the findings of several studies (Buckhalt, Rutherford, & Goldberg, 1978; O'Kelly-Collard, 1978; Rondal, 1977) that observed caregivers regulating their speech to match their (disabled or nondisabled) child's level of comprehension. It should be noted that this behavior is in accordance with the general literature on maternal speech to developmentally young infants (see previous section of this chapter). The caregiver's recognition of the child's level of functioning (whether disabled or nondisabled) leads to alteration of speech to enhance communication and understanding (Chapman, 1982). Rondal (1977) affirms that the child's ability to comprehend the caregiver has a powerful impact on the caregiver's style of speech. Consequently, the social role that develops in communicative interactions between adults and children with disabilities influences what children learn about the communication process and about themselves as communicators (Mundy et al., 1985).

Characteristics of Caregiver Interactional Style

The child with disabilities exhibits differences in early interactions that may affect the developing relationship and communicative development. Caregiver's early feelings of disorganization (Bailey & Slee, 1984; Odom, 1983); anxiety regarding the child's survival and/or development (Clark & Seifer, 1983; Hodapp & Goldfield, 1983); the initial shock and continual adjustments (Kelly, 1982); and the process of grieving (Als, 1979; Urwin, 1984) may contribute individually or collectively to the disruption of early communicative processes. Instead of experiencing warmth and nurturance, the caregiver may feel anxious and helpless. The infant born with disabilities may not readily achieve attachment to the caregiver, thereby inhibiting a mutually reinforcing relationship. The caregiver's contact with the child is usually disrupted due to increased dependence on professionals to provide intervention for the child. This allows less opportunity for the caregiver to establish a working communication system with the child (Kent-Udolf, 1984). The caregiver-infant rapport that is established normally in the first few weeks of life may be jeopardized by the caregiver experiencing extreme loss, frustration, and emotional upheaval, resulting possibly in withdrawal and unconscious or partial rejection of the child (Bricker, Levin, & Macke, 1984).

Caregivers respond to varying forms of disabilities in their infants in different ways. Caregivers of infants with blindness cannot establish initial contact through eye gaze or facial expressions; yet, displaying eye gaze and facial expression is one of the primary ways that caregivers and infants without disabilities experience their first exchanges. Therefore, caregivers of infants with blindness experience tremendous difficulty establishing a communicative base (Fraiberg, 1977; Thelan, 1985). The lack of this basic component of communication is also seen in interactions with infants with autism. The adult's facial expressions that normally delight the infant without disabilities are observed by the child with autism as fairly unpleasant. In this case, the vocalizations and gestures of the caregiver hold little positive meaning. The child's withdrawal from the caregiver's facial expressions and communicative attempts increases isolation that threatens the child's role as a future communicative member (Newson, 1984).

Although many different communicative problems can exist within the dyad that includes a child with disabilities, recent literature has focused on ways that caregivers and such infants adapt their behaviors to facilitate communication (Rogow, 1984; Walker et al., 1982). One way that infants with visual disabilities compensate for the lack of eye contact in their nonsymbolic behavior is by using their hands and bodies extensively. Caregivers adjust to the different signals of their infants. Fraiberg (1979) observed caregivers responding to the infants' habit of becoming perfectly still, which they use as a sign to communicate interest or attention to the adult. Clearly, caregivers do take special care to adapt to their infant's needs, but, the initial disruption in interactions may continue to be reflected in caregiver-child interchanges over time.

It is important to recognize that interaction patterns with an infant displaying disabilities may be frustrating for the caregiver and confusing to the infant (Bricker et al., 1984). It is difficult to discern if caregivers are performing in a manner that is inappropriate or detrimental to the infant since they are continually trying to compensate for a lack of responses, contingency, and a natural rapport with their infant. Some researchers have studied certain traits found in maternal speech among infants with disabilities that differ from the nondisabled dyad (Breiner & Forehand, 1982; Chapman, 1982; McConachie & Mitchell, 1985). With infants experiencing Down syndrome, mothers were observed using a shorter length of utterance, a simpler sentence complexity, and more corrections and prodding (Chapman, 1987). Caregivers with infants displaying mental handicaps and developmental delays tend to give more inconsistent and infrequent feedback (Jones, 1977; Vietze, Abernathy, Ashe, & Faulstick, 1978). Similarly, Breiner and Forehand (1982) reported caregivers of infants with mental retardation issuing four times as many vague and interrupted commands as caregivers of infants without mental retardation. Preoccupied with eliciting their idea of appropriate participation, the caregivers were less likely to recognize and respond positively to the infant's behavior (Cunningham, Reuler, Blackwell, & Deck, 1981; Terdal, Jackson, & Garner, 1976). They seemed to underestimate their child's need for positive reinforcement at appropriate times (McConachie & Mitchell, 1985). Kogan, Wimberger, & Robbitt (1969) found that caregivers and their infants with mental retardation "did nothing together" in a play setting more often than any other activity. In contrast, caregivers and their children without mental retardation frequently took turns with each other in their play interactions. It is interesting to note that caregivers of higher functioning children with mental retardation have been observed responding more contingently to their children than caregivers of lower functioning children, who responded in more diffuse and nonattentive ways (Vietze et al., 1978). Similarly, in classrooms for students with severe multiple handicaps, the teachers used less directive speech, and specifically, fewer requests for action, when interacting with their higher functioning students (Stillman & Battle, 1986). The lack of reliable input from the caregiver, in addition to weak responses to the child with disabilities, may perpetuate poorly developed patterns of interactions (Rowland, 1984).

Within the literature (across a number of disabling conditions including pre- and postterm infants, children with Down syndrome, developmental delays, hearing impairments, visual impairments, physical disabilities, and deaf-blindness, particular aspects of caregiver differences have been cited as important to understand within early interactional patterns. These identified differences between caregivers and children with disabilities and children without disabilities involve (a) higher rates of caregiver initiation, (b) overstimulation of the infant, (c) controlling or directive caregiver behaviors, and (d) differences in interactional patterns over time.

Caregiver initiation. Research indicates that caregivers of children with disabilities initiate more interactions than caregivers of children without disabilities (Brooks-Gunn & Lewis, 1984; Lamb, et al., 1982). In their study of mothers' speech to prelinguistic children with Down syndrome, Cardosa-Martins and Mervis (1985) suggest that such children are more passive and less responsive than children without disabilities. As a result, they may provide fewer communicative signals and may leave the responsibility of initiating interactions to the caregiver.

Several studies document characteristic deficits in the communication attempts of the infant with disabilities. Their cues are difficult to interpret and may be issued in inappropriate or noncontingent ways (McConachie & Mitchell, 1985). There are fewer instances of eye contact (Field, 1983), infrequent vocalizations (Hanzlik & Stevenson, 1986), and fewer initiations of an exchange (Bailey & Slee, 1984; Marfo, 1984). There are overall lower activity levels, more repetitive behaviors, and fewer contingent responses (Walker et al., 1982). In addition, their vocalizations may occur in an echoic and asynchronous manner, restricting the caregivers' opportunities to respond in a timely fashion (Buckhalt, Rutherford, & Goldberg, 1978; Marfo, 1984). Bakeman and Brown (1980) noted that caregivers of infants with disabilities assume the role of the prominent interactive partner. It is speculated that the caregiver is compensating for the inactivity of the infant and attempting to maintain some degree of activity or interaction (Bailey & Slee, 1984). The caregiver may also be attempting to elicit the level of behavior found in children of the same age without disabilities. The desire to encourage the child with disabilities to perform at a possibly unrealistic level may account for the frequency of directive behavior. Also, the caregiver is continually adapting to the infant's low level of self-initiating behavior, trying to elicit maximum responses from the infant (Field, 1983).

In contrast to this research, Walker and Kershman (1981) found that caregivers of children with deaf-blindness were less active than the caregivers of infants without disabilities; however, caregivers of the children with deaf-blindness were more active in proportion to their children's activity. It is interesting to note that caregivers will tend to stimulate infants who appear awake and alert but will be quiet and gentle with a fussy baby (Als, 1977; Hodapp & Goldfield, 1983). This would imply that more "difficult" infants receive less input than the pleasantly responsive baby. Of course, differences in caregiver behavior must be interpreted in relationship to the child's individual communicative behaviors. Infants and children with disabilities may influence their caregivers to provide different rates of interactive bids and responsiveness (Bricker & Carlson, 1980).

Caregiver overstimulation. Caregivers of infants and children with disabilities, or children who are at risk, work harder in communication exchanges with their children than do caregivers of infants without disabilities (Bakeman & Brown, 1980; Clark & Seifer, 1983). They have been found to overstimulate their infants (Carlson & Bricker, 1982; Clark & Seifer, 1983; Field, 1979). With infants who were blind, caregivers provided continual vocalizations in an attempt to encourage responses (Rowland, 1984).

The lack of pauses in the interaction due to this constant vocalizing can be very damaging to rapport. An overstimulated infant responds with gaze aversion and avoidance behaviors while the caregiver continues to try to elicit responses (Clark & Seifer, 1983; Field, 1977).

Field (1983) found that caregivers of pre- and postterm infants talked more than caregivers of infants without disabilities. Also, the more the caregiver vocalized to the infant, the more this resulted in gaze aversion. Repeated exposure to this imbalanced style of interaction may lead children to develop a negative or passive view of their roles as communicators. They may become reluctant to initiate communicative acts and may be comfortable only with a passive role (Mundy et al., 1985). Caregivers of infants without impairments usually reduced their input when the infants responded with some form of positive behavior (i.e., smiles and laughter). Conversely, caregivers of infants with disabilities did not act in this way. For example, with the infant who responded positively less often, caregivers maintained or increased their input in order to produce continual responses. This persistence on the caregiver's part to provide excessive stimulation was inevitably counterproductive for the infant. The infant's gaze aversion might be interpreted as a sign that the infant needs time to process the caregiver's input. An infant's negative affect or high arousal behavior in an interactive exchange may be directly related to information overload. Overstimulation may disrupt the interactional process, leading to asynchronous exchanges.

Brinker and Lewis (1982) noted that interactional responses of infants with Down syndrome are not as cyclical as those of infants without disabilities. Infants with Down syndrome, in particular, have been noted to vocalize more repetitively over a prolonged period of time, not allowing the caregiver to respond at appropriate intervals (Jones, 1980). Turn taking is an integral component of communicative competence; however, it is noted that children with disabilities do not generally acquire the necessary components of turn taking that are essential to communication (Schiefelbusch, 1984). Whether it is the caregiver who is overstimulating by not being sensitive to potential nonsymbolic expressions or the infant who is babbling without concern for the caregiver's feedback, both factors can result in an increase of vocal clashes. Thus, caregivers of infants with disabilities may experience more difficulty structuring their own behaviors in a responsive, reciprocal manner.

Caregiver directive and controlling behaviors. Research indicates that caregivers of children who are disabled are more controlling and directive within interactions than are caregivers of children without disabilities (Brooks-Gunn & Lewis, 1984; Cardosa-Martins & Mervis, 1985; Clark & Seifer, 1983; Jones, 1980; Tyler & Kogan, 1977). Control or directiveness has been shown to relate negatively to the development of the child without disabilities (Mahoney, Finger, & Powell, 1985) and may therefore affect the child with disabilities in a similar manner (Clark & Seifer, 1983). One reason that overstructuring may be detrimental to the dyad is due to the relationship between parental responsiveness and decreased directiveness. When caregivers are not concerned with eliciting specific responses, they can be more sensitive to the spontaneous behaviors of the infant that may be used to initiate an exchange (Hanzlik & Stevenson, 1986; Tyler & Kogan, 1977). Interactions dominated by the caregiver usually result in reduced responsiveness to infant behaviors (Brinker & Lewis, 1982). Caregivers who dominate interactions may respond too quickly or too often, thereby missing natural opportunities to respond to their infants (Carlson & Bricker, 1982; Walker et al., 1982). As a result, the infant has few occasions to initiate or control interactions. The lack of opportunities to respond may lead to the passive or apathetic behavior frequently evident in infants with disabilities (Carlson & Bricker, 1982; Urwin, 1984).

Cardosa-Martins and Mervis (1985) suggest that caregiver directiveness may be a response to infrequent and unclear communicative signals from the infant. The fact that the infant with disabilities may be inactive, fussy, and not responsive may be seen as aversive by the caregiver. The frustration of receiving minimal responses from the infant may lead to a kind of aggression or hyperactivity on the part of the caregiver. Attempting to compensate for the child's inactivity or inappropriate responses, the caregiver may feel the need to carry the bulk of the conversation. This leads them to impose greater structure by the use of directives and commands in an attempt to force some response (Bell, 1971; Marfo, 1984; Tyler, Kogan, & Turner, 1974). Terdal et al. (1976) found that mothers responded to their infants' inadequate communicative attempts by increasing the structure and control of the interaction, regardless of developmental ability. In addition, caregivers of infants with disabilities are dealing with a more limited range of optimal stimulation. A lower level of stimulation may result in no response; a higher level may result in withdrawal. Caregivers must work harder to elicit responses but, at the same time, they must be careful not to overstimulate the infant, who may then respond aversively and be harder to console. The caregiver's frustration with the child's lack of readable messages is mixed with the desire to compensate for the infant's communicative helplessness. The caregiver must not only speculate at the meaning of many of the infant's messages, but also take care not to reach the infant's delicate frustration level. The caregiver's attitude toward the infant with disabilities may aid or inhibit the process of interpreting the child's desires and perceiving the infant's immediate receptivity.

One of the most obvious forms of overdirective caregiver behavior is the use of commands. Studies observing caregivers in interactions with their infants with disabilities cite this factor as characteristic of the dyad (Bailey & Slee, 1984; Hanzlik & Stevenson, 1986; Kogan, 1980; Marfo, 1984). An interesting aspect of this behavior noted by Hanzlik and Stevenson (1986) is that infants tend to respond in two somewhat negative ways: (a) disinterested compliance or (b) resistive, competing behavior. Disinterested compliance can be described as too passively accepting a statement in a seemingly detached manner or with inactive disregard for the caregiver. Resisting or competing behavior may take the form of refusal or avoidance. Due to the fact that infant behaviors may not be emitted frequently enough for maternal expectations, the caregiver may attempt to elicit more behavior through prompts and directives. As a result, complying and competing behaviors occur much more frequently for infants with disabilities than infants without disabilities. The actions of an infant without disabilities include more initiations and a genuine interest in the adult's exchange. This is viewed positively by the caregiver and reduces the need for commands.

Infants and children with disabilities respond with a lack of contingency (Odom, 1983) and are less likely to include the caregiver naturally in their activity (Walker et al., 1982). Caregivers may be more controlling and directive because the child with disabilities is less able to interact with the environment and must rely on the caregiver to provide access to it (Urwin, 1984; Walker et al., 1982). For infants with disabilities, the physical environment may change less frequently, since they are dependent upon caregivers to bring the environment to them (Yoder & Kraat, 1983). Meanwhile, the caregiver, viewing the infant as more fragile and delayed, may be overprotective (Field, 1983) and overly concerned with exactly what kind of environmental stimulus the infant is receiving. These factors contribute to an unnatural learning environment, devoid of normal infant exploration and discovery. In effect, the caregiver is placed in a controlling position with a role that is not defined. Caregiver dominance and control of early communicative interchanges may be influenced not only by child behaviors but also by caregiver perceptions of their roles within exchanges.

Furthermore, caregivers of infants with disabilities may be controlling and directive within interactions because they view themselves as teachers (Clark & Seifer, 1983; Walker et al., 1982). Studies have shown that caregivers exhibit more directive and controlling behaviors when placed in the context of teaching their infant or child (McConachie & Mitchell, 1985). As discussed earlier, caregivers are less dominating and more responsive to their child within a play context (Bretherton & Bates, 1979; Walker et al., 1982). Caregivers of children with disabilities may be more involved in daily teaching contexts and may be more likely to exhibit directive and controlling behaviors that are associated with the teaching role often seen in the classroom and therapy environment. Stillman and Battle (1986) examined the forms of communicative behavior used by teachers of students with severe multiple handicaps and found that directive forms were used most frequently, often focusing on a request for action or request for communication. The role that develops between adult and child is often characterized as a didactic relationship, lacking in turn-taking opportunities and confining the child to a listener or responder role.

Unfortunately, these interactions are much less enjoyable for both caregiver and infant (Walker et al., 1982). Field (1983) reported that high-risk infants demonstrate less positive affect, less attentiveness, and less frequent game playing with their caregivers. The caregivers also exhibited less positive affect and showed less interest in playing with their infants. It was speculated that caregivers may have tried to elicit the positive responses from their infant that are usually experienced in a playful, game setting. The at-risk infant, however, may have responded negatively, feeling that the caregiver's playful stimulation is too persistent or not understandable. The infant's aversive behavior then affects the caregiver, decreasing the expectation of a happy interaction and causing the caregiver to hesitate to initiate a game or playful sequence.

Caregivers of infants without disabilities not only play more games but play a greater number of different kinds of games. The lack of frequent game playing between caregivers and infants with disabilities may be due in part to a greater incidence of negative affect observed among at-risk infants in a play or game setting (Field, 1983). The failure of the dyad in their early game interactions may lead to a feeling of increased stress or frustration for both caregiver and infant. In short, the very setting that produces a warm and mutually satisfying interaction with infants who are not disabled has the potential to produce the opposite effect with a more irritable and less responsive infant.

Yoder and Kraat (1983) also recognized that simple activities of daily life, such as feeding and bathing, are experienced normally as playful and rewarding times. Interactions with the infant experiencing disabilities, however, show that these aspects of routine care may contain a degree of frustration and tension for both caregiver and infant. The infant's limited mobility, uncontrolled movements, lack of readable responses, or affective clues, contribute to the caregiver's feelings of confusion and inadequacy. They may begin to fear that future interactions will be frustrating and this negative association may reduce the caregiver's attempts to communicate and play with the infant. The history of failure in caregiver-infant interactions leads to decreased social interactions that create a lack of positive opportunities for communicative development. Field (1983) also reported that infants without disabilities exhibited significantly more happy facial expressions than infants considered to be at risk. Infants in the former group showed contingent smiling, vocalizing, and frequent cooing. Infants in the latter group demonstrated more sad faces and cried more frequently. In addition, caregivers of at-risk infants also showed fewer happy expressions. It seems apparent that the less positive emotional environment found in the disabled dyad reduces opportunities for positive communicative exchanges and increases the likelihood of poor interactive behaviors.

Caregiver interactional patterns over time. Caregivers of children with disabilities may continue to differ as time progresses (Bricker & Carlson, 1981; Brinker & Lewis, 1982; Crnic et al., 1983; Snow, 1984; Walker, 1982). Studies of interactions with preterm infants have found that caregivers exhibit less positive affective involvement over the first 2 years and enjoy interactive exchanges less than caregivers of full-term infants (Barnard, Bee, & Hammond, 1984; Crnic et al., 1983). Caregivers of at-risk infants may work hard at eliciting some degree of interaction from their child for the first 2 years. Several studies have reported a progressive reduction of maternal interaction and emotional involvement after this 2-year period (Bricker & Carlson, 1981; Kogan, Tyler, & Turner, 1974; Tyler & Kogan, 1977; Wasserman & Allen, 1985). Als (1982) suggests that the expectation for failure accumulates over time and caregivers may tire of the wearing, continued demand of their infant who is severely disabled. Berger and Cunningham (1983) state that during the first 6 months of life, the caregiver's attempt to adapt to the behavior of the infant with disabilities is less successful than for the caregiver of the infant without disabilities.

As infants and children with disabilities show cumulative developmental deficits, caregivers continue to experience frustration and discouragement (Snow, 1984). Brinker and Lewis (1982) propose the "practiced mother hypothesis" (p. 7), suggesting that caregivers of children with disabilities have a long period of time to become established in an interactive pattern. This "may produce a desensitization in the mother's ability to detect infant changes" (p. 7). As a result, changes in the infant's development may not be recognized by the caregiver. Caregivers may respond differently to behaviors their child exhibits as the child grows older (Brooks-Gunn & Lewis, 1982). For instance, Brooks-Gunn and Lewis found that fretting was responded to less often by caregivers of older infants with disabilities than by caregivers of younger infants with disabilities. These authors also found that caregivers of children with disabilities rated their child as being more difficult as the child's age increased. This may reflect the increasing gap between the behavior of their child and children without disabilities (Arkell, 1982; Snow, 1984). Recurring crises may result from the child's slow developmental change or lack of growth of typical communicative patterns (Walker, 1982). Differences in the interactional process may continue to affect communicative exchanges between the caregiver and the growing child with a disability. When caregivers become increasingly distressed with the lack of synchrony in their interactions, they often become less attentive and, correspondingly, less competent as responsive partners (Bricker et al., 1984).

The pattern of interaction that develops between caregiver and infant is crucial in the development of the child's future acquisition of language and communication. Beckwith, Cohen, Kopp, Parmalee, and Marcy (1976) in a 2-year followup study observed that disturbances in interactions early in infancy lead to increased communicative difficulties later. In fact, the best predictor of a child's developmental status at 2 years of age is the pattern of interaction observed between caregiver and infant in the first 2 months of life (Bakeman & Brown, 1980; Sigman, Cohen, & Forsythe, 1981). The importance of caregiver nurturance and support for infants who are disabled and nondisabled has been studied by several researchers (Cohen, Beckwith, & Parmalee, 1978; Egeland & Sroufe, 1981; White, 1978). Caregivers of infants without disabilities who were considered to be psychologically unavailable and emotionally uninvolved consistently produced toddlers who scored significantly lower on cognitive, social, and linguistic tests. Whatever the cause of maternal detachment, there appears to be a positive correlation between the nonresponsiveness of the caregiver and the infant's eventual overall performance level.

It is clear that differences exist in interactional patterns between caregivers and their children with disabilities. The infant or child with disabilities, as a less competent communicative partner, affects the process and continues to modify caregiver-infant interactional patterns (Hanson, 1982). Caregivers respond with higher rates of initiation, overstimulation, and controlling and directive behaviors. Future research efforts need to be directed toward identifying caregiver behaviors that are more beneficial for the infant or child with a disability (Walker, 1982; Walker & Kershman, 1981).

Intervention Strategies for Facilitating Nonsymbolic Communicative Competence

The processes of nonsymbolic communication that exist for the caregiver and the infant with disabilities are complex. To establish some basis for early communicative exchanges, the caregiver must adjust to the current skill level of the infant. Infants who are blind may be limited to tactual and vocal input; infants with mental retardation may have difficulty interpreting and sending messages; infants with autism may be confused and frustrated by the stimuli in their environment; and infants who are deaf-blind and experience other physical and mental disabilities are particularly isolated from their caregiver's communicative attempts. Although more research is needed to understand and facilitate communication for these special infants and children, some studies have outlined various approaches for intervention with infants who are at risk and for caregivers who experience their asynchronous interaction patterns (Carlson & Bricker, 1982; Clark & Seifer, 1983; Cole & St. Clair-Stokes, 1984a, 1984b; Kelly, 1982; Lamb et al., 1982; Odom, 1983).

The forthcoming synthesis of infant-caregiver dyads and related intervention is related directly to similar intervention with parents and service providers (educators, paraprofessionals, therapists) in programs for young children with severe disabilities or deaf-blindness. The information on nonsymbolic facilitation between caregivers and infants is of tremendous benefit to conducting intervention programs for students with disabilities who function at similar communicative levels. We believe that service providers, over time, assume similar roles to caregivers as they establish nurturant, reciprocal roles with individual children in their programs. The daily caretaking roles of attending to physical needs, responding to nonverbal requests, and participating in social interchanges, occur between the adult and infant/child in home and educational settings. Those qualities and skills that have been found to be beneficial in infant research and intervention programs may be valuable assets in related intervention for young children with severe disabilities or deaf-blindness (Holdgrafer & Dunst, 1986). Two components that incorporate the findings of much of the literature on communication intervention are (a) perceiving and utilizing the child's existing nonsymbolic skills, and (b) focusing on the context of the interaction.

Utilizing the Child's Nonsymbolic Skills

The first aspect, involving the acceptance of the child's present abilities utilizes three important variables of nonsymbolic communication already discussed: sensitivity, timing, and contingency. Recent literature has focused on the importance of the primary caregiver's understanding and knowledge of the infant (Johnson & Barton, 1984; Reuter & Clow, in press; Stancin, Reuter, Dunn, & Bickett, 1984). Recognition of attempts at communication and the ability to interpret the nonsymbolic messages naturally become easier as the caregiver's experience with the child increases. Primary caregivers then are undeniably the infant's best interpreter because they have had the most experience with the infant. Johnson and Barton (1984) reported an accuracy rate of 89 percent for caregiver's of children with multiple disabilities when asked to project the child's

behavior in different settings. This suggests that caregivers of infants with disabilities do have an accurate understanding of the possible behavior patterns of their children within interactional exchanges. When implementing intervention programs, parents may be recognized as possessing invaluable expertise in the understanding of their child.

The caregivers (parents) history of involvement places them in the best position to be sensitive to their infants; consequently, intervention programs should allow them to remain in contact with the infants during intervention. Likewise, other family members, such as siblings, who are a significant part of the child's natural environment, should be encouraged to participate in communication facilitation to allow further reciprocal social interactions to occur. James and Egel (1986) observed when nonhandicapped siblings became involved in the intervention, the child with disabilities showed increases in levels of initiations and responsiveness and a greater ability to generalize newly acquired skills to other settings. While incorporating the participation of family members, it is important for the existing relationship between infant and all care providers to be reinforced, rather than having the facilitator serve as a model to be imitated (Kelly, 1982).

In fact, the caregiver's natural communication style should be modified slightly and in ways that can be easily incorporated (Calculator, 1984). The facilitator should encourage caregivers to feel confident with their current knowledge and comprehension of the child's communicative signals. The caregivers may need encouragement to accept the child's nonsymbolic signals as legitimate attempts at communication. They need to recognize unusual cues and signals (e.g., open mouth, groan, yawn, change in muscle tone) as possible responses or attempts at conversation (Lamb et al., 1982; Ludlow, 1981; McCollum, 1984). Additionally, there are several infant behaviors that the caregivers can focus on that may encourage social exchange and promote synchrony in the dyad. The infant's contingent vocalizing, sustained eye contact, or vocalizations timed with those of the caregiver can serve as strong social reinforcers for the caregiver. Additionally, reaching for and manipulating objects is a common way in which infants initiate topics that the caregiver can elaborate on, thereby enhancing shared mutual attention (Calculator, 1984). Accepting the child's existing repertoire of communicative behavior and enhancing the caregiver's sensitivity to these behaviors facilitates communicative intervention (Johnson & Barton, 1984). Using the caregiver appropriately in an intervention program, may enhance the degree of sensitivity and responsiveness to the child.

Although caregivers may naturally be the most sensitive to their infants, there are additional ways that their sensitivity may be developed further. Within the dyad, the caregiver may have difficulty in decoding the child's messages and may experience frustration due to vocal clashes, asynchronous exchanges, and lack of contingent feedback. The infant may also be experiencing similar confusing interchanges. A focus on timing, particularly turn taking, can increase sensitivity and improve communication within the dyad. Turn taking is especially important as it establishes communication patterns and reciprocal skills in both children with disabilities and their caregivers. MacDonald and Gillette (1984, 1985) in particular, stressed the importance of developing turn-taking skills, providing specific instructional guidelines that can be incorporated into natural interactions.

The role of turn taking, pauses, vocal coaction, and the effects of the mental and/or physical disabilities of one partner have been discussed previously. One frequent problem that can disrupt the turn-taking aspect of the dyad is overstimulation. The caregiver's tendency to vocalize frequently and persistently can be decreased by encouraging the caregiver to insert pauses while interacting with the child. If the

caregiver withholds input when the child looks away or shows disinterest, a necessary interval is provided for the child to process information (Field, 1983). Vocalizations from the caregiver occurring a short time after the child stops vocalizing, reinforce the concept of turn taking and help to avoid interruptions. Depending upon the child's disability, special adjustments can be made to enhance the child's perception of pauses and taking turns. For example, a child with visual impairments may need to be cued to silent intervals by placing a hand on the adult's mouth allowing them to feel the speech act and the silence (Rowland, 1984). Short periods of language stimulation interspersed with short periods of silence, create an optimum setting for learning through "conversation." Each of these features helps to reduce caregiver dominance, allowing time for the child's turn (Marfo, 1984). In addition, caregivers can learn to adjust their level of input to the child's varying responsiveness by identifying the child's signs of readiness or nonreadiness for interaction. The occurrence, rate, and magnitude of children's responses may depend largely on their mood at the time of the encounter (Calculator, 1984).

If caregivers and service providers can improve their observations of the child's social and communicative behavior, they may develop increased sensitivity to the child and the use of appropriate pauses. The purpose in adjusting the interactional behaviors of caregivers should be to increase the likelihood of children understanding the value of their behaviors, instilling in them a reason to communicate (Calculator, 1984). Sensitivity to the child's timing will help predict the necessary turn-taking aspects of the interaction and will allow the adult to provide more contingent responses and cues for the child. The vocalizations of the child should be reinforced frequently and consistently. One excellent way to demonstrate this type of encouragement is through imitation and expansions of the child's utterance (Carlson & Bricker, 1982; Clark & Seifer, 1983; Odom, 1983). When the adult's vocal reinforcement contains an imitation of the child's sounds, it often prompts the child to vocalize again. In addition, caregivers who frequently expand on their child's vocalization or gesture have created perfect opportunities for increasing the interaction time (Chapman, 1982). The child's communicative signal is received, interpreted, and elaborated in such a way that the child still recognizes the initial sound or gesture and is intrigued by the slight variation the adult has added. This encourages the child to try to imitate the expansion of the adult (Mitnick, 1984). Folger and Chapman (1978) found that when adults expanded on the child's initial cue, the child responded frequently with an immediate imitation of the adult. This level of perception by the child involves an awareness of contingent and predictable patterns in their interactions with the adult. The two strategies, imitation and expansion of the child's communicative behavior, provide additional opportunities for repeated positive interactions between adult and infant. To incorporate these aspects within an intervention program, efforts should be made to increase contingency for both members of the dyad.

Unlike the caregiver of the child without disabilities, the caregiver of the child with multiple disabilities has few guidelines to assess the child's progress (Bailey & Slee, 1984). Additional techniques and programs must be developed to help the caregiver interpret and respond constructively to the infant with disabilities. Analyzing the existing interactions may be helpful in observing particular patterns that arise and how they may be improved (Holdgrafer & Dunst, 1986). Some of the potential problems discussed in this section (caregiver's overstimulation, frustration with or insensitivity to the child's timing, confusion with the child's signals) can be benefited by employing some of the strategies mentioned, including awareness of the child's need for rest intervals, the use of appropriate pauses, acceptance of the child's existing skills level, and imitation and expansion of the child's communicative behavior.

Focusing on the Context of Interactions

The second important aspect that should be recognized in an intervention program is the use of appropriate contexts to facilitate communicative exchanges. Identifying those settings where children are functioning at their optimum communicative level is of prime importance. Familiar contexts provide significant structure for the infant's development of communication because they contain many situational cues. Some familiar contexts for the infant/child with severe disabilities that occur throughout the day include care routines (feeding, bathing, and diapering) and social routines (playtime and games). Activities that are part of the daily routine should occur within a repetitive sequence with clear cues to signal the beginning and ending of the activity (Halle, 1984). Using daily recurring contexts cues the child to a familiar routine or game, creating a prime setting to strengthen and expand the existing communicative repertoire.

A recent focus for intervention programs is the emphasis on naturalistic approaches when identifying a setting for communicative exchanges (Campbell & Stremel-Campbell, 1982; Halle, Marshall, & Spradlin, 1979; Mirenda, 1984). Communicative opportunities can be extended into many natural contexts of the day (eating, toileting, bathing, dressing) so that functional skills are learned that are also appropriate to the child's daily environment (Kent-Udolf, 1984). An environment that supports spontaneous child engagement and includes incidental teaching interactions will facilitate learning and promote the use of newly learned behaviors across different domains (Halle, 1985). The transdisciplinary approach is one method that requires input and intervention efforts from a variety of disciplines (e.g., special education, speech therapy, physical therapy) as well as support from parents, to ensure that training is generalized to functional contexts. This integrated training approach, in which skills from different areas are learned concurrently, enhances functionality and may improve the child's ability to transfer learned skills to different contexts (Warren, Alpert, & Kaiser, 1986).

Within a classroom, instructional methods would involve an awareness of opportunities for social interaction that arise naturally in the course of the day (i.e., preparing a snack, putting on shoes and coats). Situations that appear to enhance social interactions (e.g., one-on-one interactions when the child is dressing, bathing, or going to bed) and high interaction contexts with others (e.g., meal time, transportation times, and activity periods) may be identified and analyzed to increase social participation for the individual with disabilities. Additionally, caregivers may use the immediate actions and events of the child and follow the child's referential vocalizations or gestures to capitalize on the child's interest and involvement (Calculator, 1984).

Generally in a classroom for children with severe disabilities, the environment is overprogrammed and controlling, allowing few opportunities for spontaneous interaction or child-initiated exchanges (Guess & Siegel-Causey, 1985; Orlansky, 1979). An innovative strategy that can be used to increase vocal exchanges or interactive opportunities in the natural context of the classroom is the practice of delaying an expected motion or event. Halle, Baer, and Spradlin (1981) found that when the teacher withheld the anticipated action of putting on a coat or passing out a snack, there was an immediate increase in verbal responses from the children. Using predictable, naturally occurring elements of the day may provide the child with consistency and enable them to anticipate forthcoming events. By delaying slightly when carrying out an activity, the service provider arranges an environment in which the child, anticipating what should come next, displays communicative expressions to ensure the continuation of the activity (Halle, 1985). When the child's expressive behavior is responded to immediately, some degree of control over the environment may be realized. Utilization of this strategy with children experiencing multiple disabilities may help them recognize a predictable

social world that responds contingently to their signals. Rogow (1984) suggests that it is primarily within the structure of social routines that children with multiple disabilities learn they can achieve responses from adults and acquire meaningful signals.

Another strategy that can be used in natural settings at home or in the classroom involves providing children with opportunities for increased control over their environment (Peck, 1985). This includes arranging aspects of the environment to provide the child with situations that encourage self-initiated behavior and choice-making skills. Opportunities can be provided that prompt the child to initiate an interaction or make a decision involving the immediate situation. By integrating choice-making opportunities throughout the day, the child is permitted to exercise initiative and to experience the consequences of personal decision making (Shevin & Klein, 1984). Choice making gives learners the opportunity to learn from their mistakes or to experience success, which helps to develop a stronger self-concept and a more self-reliant attitude in the individual. Opportunities can be arranged that allow students to perform for themselves, to feel more effective and in control of their lives (Harrell & Strauss, 1986). Whether it is a choice over which game to play, which snack to eat, or what color toy to pick, the child is encouraged to demonstrate control over the immediate situation, promoting decision making and increased independence (Shevin & Klein, 1984).

Service providers in school settings may reduce opportunities for communicative interactions by performing daily tasks for individuals with severe disabilities without involving them in a social exchange. In fact, Mittler and Berry (1977) speculated that individuals with severe disabilities generally function at a level below their capabilities (especially in the area of communication), due in part to the failure of caregivers to provide appropriate opportunities for communication in everyday settings. Inadvertently eliminating interactions by doing tasks for the individual often results in a sense of learned helplessness in the child. There is little reason for the individual to communicate since the service providers are so adept at anticipating and providing the individual's needs, thereby eliminating any natural requests (Halle, 1985). When individuals must request assistance from a service provider to obtain something they need or desire, a situation arises that naturally motivates initiation of a communicative exchange. To capitalize on these opportunities, service providers can withhold assistance, when appropriate, until the individual asks for help. In addition, desirable objects can be placed where they are inaccessible, but still in sight, thus prompting the individual to request them (Alpert, 1984).

These strategies can be incorporated as a part of incidental teaching strategies that may occur throughout the day (Hart & Risley, 1975). When the context is arranged to facilitate these opportunities, individuals have more reason to request help since they are strongly motivated to fulfill their specific desires (Halle, 1984). Education and rehabilitation settings need to offer an array of options for increasing the quality and quantity of communication opportunities so that exchanges become more meaningful and relevant to the individual (Harrell & Strauss, 1986). Providing opportunities that enhance the individual's likelihood of becoming more independent and communicatively competent should be considered as much as possible (Calculator, 1984).

To promote these opportunities further, caregivers must be trained to work with children experiencing disabilities in a facilitative, as opposed to a directive, style. An important aspect of the facilitative style is the caregiver's high level of responsiveness to child-initiated interaction. Mirenda (1984) found that use of a facilitative style increased child-initiated interactions, question asking, and the initiation of new topics; whereas the directive style was associated with an increase of nonrelated child utterances. Selecting activities that encourage the child to use existing communicative

strategies, and imitating and elaborating on social imitations or responses facilitates the interactional process and indirectly cues the child for further communicative behavior (Peck, 1985; Schiefelbusch, 1984).

In addition to using natural teaching opportunities that arise in the course of daily activities, it may also be beneficial to incorporate the playful spirit that occurs in the social interchanges of games and playtime. The context of play or games appears to facilitate caregiver and child responsiveness and provides more opportunities for enjoyable, reciprocal interactions (Hanson, 1982). Incorporating playful activities into each day helps reduce the caregiver's tendency to be overdirective and controlling since these negative behaviors occur much less often in a relaxed "nonteaching" atmosphere. Throughout the day, service providers and caregivers should be encouraged to interact with the child in a playful way (Hodapp & Goldfield, 1983). Adults who care for children in a nurturing manner, comforting, consoling, and encouraging them, are providing a dependable framework for these children to develop and enjoy interactions. When children are assured of the adult's availability and responsiveness, a secure base is provided and they can devote themselves more readily to exploring the world (Bates et al., 1982; Kaye, 1982). This positive spirit helps to create a feeling of mutual interest and cooperation, and further develops a warm emotional bond within the dyad. In turn, this emotional tie aids in future interactions. For example, Emde and Brown (1978) found that parents who were able to elicit a social smile from their infants with Down syndrome at 4 months of age were most successful at developing close bonds with the infant.

Establishing a warm, playful spirit in daily routines and games contributes to the support of interactive exchanges by providing opportunities for more enjoyable interchanges. Studies have shown that caregivers are more responsive to their child's communicative attempts within play situations (Bretherton & Bates, 1979; Clark & Seifer, 1983; Sachs, 1984). In fact, Walker et al. (1982) found that caregivers responded more frequently to their infants and children who were nonsymbolic in a play setting than in a nonplay setting. In addition, the infants vocalized more in a play situation thus creating more vocal interchange between caregivers and infants and the appearance of a conversational exchange. Obviously the establishment of an atmosphere that continues to facilitate the infant's communicative and social development is essential.

Many early intervention programs use common social games to facilitate the child's communication (Coggins & Sandall, 1983; Rogow, 1984; Snow, 1984). Games are especially beneficial as they provide a familiar structure that includes turn taking, reciprocal responses, and a playful atmosphere (MacDonald & Gillette, 1985). To facilitate exchanges between caregivers and their infants with multiple disabilities, it has been suggested that repetitive, interactive social games be utilized (Stillman & Battle, 1986; Walker et al., 1982). These games define the roles for each dyadic member and allow the caregiver to use the actions and vocalizations the child already displays, thus promoting successful interaction for both members.

An interesting component found in some games is the combined use of rhymes and rhythmic sequences. This repetitive, musical quality was found to be extremely helpful in focusing and maintaining the child's attention (Rogow, 1984). Children become involved in the rhythmic sequences and sound patterns associated with rhyming chants. The regularity of the rhythm appears to facilitate social and perceptual awareness and to coordinate their actions. An example of the beneficial qualities of rhymes can be observed with children experiencing many different kinds of disabilities. For example, E. Newson (1984) found that infants with autism would tolerate physical contact (i.e., sitting on an adult's lap) when the adult recited a familiar rhyme. Rogow (1984) observed

children with various disabilities responding to rhythmic games and rhymes with their least restricted modality. For example, a child with a physical disability used visual and auditory capabilities to signal interest and attention, and an infant with visual impairments would vocalize, gesture, or bounce up and down at the onset of these rhythmic sequences. The child's involvement in rhythmic games is enhanced by multiple elements (physical rocking, rhyming words, a sing-song feeling) that are an integral part of these types of games.

In this section, some approaches to intervention have been outlined for use with the infant/child with severe disabilities who is functioning at a nonsymbolic level. Emphasis has been placed on the importance of caregiver participation in the school and home setting. Utilizing the caregiver's personal history of involvement with the child, he or she may increase sensitivity and comprehension of the child's behavioral signals. Likewise, training caregivers to trust their intuitive understanding and increase their sensitivity may aid in more synchronous, well-timed and contingent interchanges. Furthermore, the training of service providers (teachers, paraprofessionals, therapists) is recommended to build similar caregiver competencies (i.e., being responsive to nonsymbolic visual, gestural, and vocal behaviors; utilizing unique visual, gestural, and vocal behaviors; and displaying sensitivity, timing, and contingency). This facilitative communication intervention focuses on guiding service providers to build a history of involvement with the nonsymbolic child displaying severe disabilities. Emulating the nurturing, reciprocal relationship of the caregiver-infant dyad may promote the service providers' sensitive communicative style with the child. Moreover, enhancing service providers' acceptance of nonsymbolic behaviors as communicative expressions may lead to an increased understanding of the child's unique timing, signals, and behavioral cues.

In addition, care should be taken to identify and arrange the home and school environment to increase natural opportunities for the child's communicative involvement. Improving aspects of the social climate by establishing a facilitative adult style should be encouraged. Increased opportunities for high quality interactions allow the child to exhibit more control over the environment. Encouraging a warm, playful atmosphere throughout the day with increased use of games, rhythmic sequences, and rhymes will help to establish a nondirective environment. These intervention strategies derived from typical interaction patterns found facilitative for nonsymbolic communicative development may prove to be valuable components for promoting communicative competencies in children with severe disabilities or deaf-blindness. The curriculum manual incorporating these strategies is currently being revised by the University of Kansas consortium site and will be discussed at the end of the following section.

Research Linkages

The ongoing research at the University of Kansas, Lawrence, has focused on validating intervention techniques for facilitating nonsymbolic communicative interactions between caregivers (teachers, parents, paraprofessionals) and children with deaf-blindness. One aspect of the research was to investigate the relationship of the salient variables of normal nonsymbolic development for young children with deaf-blindness. Project activities have included (a) single-subject design study that explores the basic assumptions of movement-based techniques (refer to theoretical exploration of van Dijk theory in Siegel-Causey & Guess, 1985), (b) development of nonsymbolic assessment tools, (c) development of a curriculum manual, and (d) field review and evaluation of the curriculum manual.

Effects of Movement and Passive Stimulation on Nonsymbolic Communication Behaviors

As the first in a series of studies, Study I examined the impact of some of van Dijk's assumptions regarding social interactions between caregivers (paraprofessionals) and six children with severe disabilities. Three of the assumptions (Siegel-Causey & Guess, 1985; van Dijk, 1965a, 1965b, 1966, 1967, 1968, 1969, 1986) that were utilized can be stated as follows: (a) An adult who has a nurturing relationship with the student delivers communication intervention while (b) maintaining direct physical contact with the student and (c) utilizing movement to promote communication behaviors. Four major research questions were addressed: (a) Were there any differences between movement intervention and passive intervention on the child participant's nonsymbolic behaviors? (b) Were there any differences between latency of the child participant's responses during movement intervention and passive intervention? (c) Were there any differences between latency of the child participant's responses within blocks of intervention training? and (d) After achieving specified competency criteria, were adult participants accurate in delivering intervention procedures during the study? A modified alternating treatment block, single-subject design was used with four participants and was replicated with two participants.

The study measured the occurrence of child-initiated responses as a function of either movement or passive stimulation via mechanical toys. Results indicated that movement was effective in increasing nonsymbolic behaviors with two participants in the study. In addition, two participants demonstrated changes in the type of nonsymbolic behaviors exhibited. Differences in the latency of responses were demonstrated for one participant during passive intervention and for two participants during movement intervention. Adult participants displayed trained competency accuracy with intervention procedural delivery (independent variable) for over half of the sessions. This research indicated that movement intervention during social interaction, a major component of the van Dijk theory, may improve nonsymbolic communication in some children with severe disabilities. Intervention models that incorporate contingent responding to a child's nonsymbolic, nonintentional behaviors may be an asset to traditional educational techniques for young children with severe disabilities.

Nonsymbolic Assessment Code (NAC)

An observational code was developed to assess the repertoires of young children with deaf-blindness or severe disabilities who have limited behavioral repertoires and who display low rates of behavior. The Nonsymbolic Assessment Code (NAC) (Siegel-Causey, 1984) consists of descriptions and corresponding codes delineating specific movements of identified body parts and of types of vocalizations. There are six areas for coding: head, eyes, arms, legs, facial expression, and vocalizations. Each area has specific codes, definitions, and separate data sheets. Observation is done utilizing a time sampling format. Completion of the Nonsymbolic Assessment Code (NAC) provides a profile of occurrences of child behavior. The behaviors of highest frequency may serve as targets for intervention (dependent variables).

Curriculum Manual: Strategies for Developing Nonsymbolic Communication

A manual has been developed (Siegel-Causey & Guess, in press) to be used by service providers (teachers, paraprofessionals, and prospective teachers) working with students with severe multiple handicaps. The manual was developed from research conducted at the Lawrence consortium site, at other sites of the Communication Skills Center, and from the information gained from three literature reviews (Siegel-Causey & Guess, 1985; Siegel-Causey, Sims, Ernst, & Guess, 1986; Siegel-Causey, Ernst, & Guess,

1987). The manual provides a philosophical orientation to communication facilitation by utilizing several guidelines to be considered by service providers implementing instructional programs. These guidelines include many of the components summarized in the intervention section of this chapter: enhancing sensitivity and responsiveness to nonsymbolic communicative behavior; developing a nurturant relationship and warm atmosphere in the classroom; increasing the individual's need and opportunity for communication; and sequencing experiences in a predictable repetitive format. In addition, the van Dijk movement-based approach to intervention (van Dijk, 1965a, 1965b, 1968, 1969, 1986) is briefly summarized and included as one of the guidelines of intervention. The manual strongly suggests that service providers should incorporate the suggested intervention guidelines in the natural context of daily life, while performing the training of functional communication skills.

Field Review and Evaluation of the Curriculum Manual

The curriculum manual, Enhancing interactions between service providers and individuals who are severely multiply disabled: Strategies for developing nonsymbolic communication (Siegel-Causey & Guess, in press) consists of three chapters. Chapter One is entitled, "Introduction: Nonsymbolic communication," and includes four sections which cover the statement of the problem, a theoretical orientation, and processes of nonsymbolic behavior with communicative functions. Chapter Two contains six sections describing intervention guidelines for developing nurturance, enhancing caregiver responsiveness, and perceiving communicative needs; achieving consistency in daily structure; utilizing natural settings; and utilizing movement. Chapter Three, entitled "Procedures for Enhancing Nonsymbolic Communication," includes a brief orientation with two example scripts that provide a dialogue description of interactions between a service provider and individuals with severe multiple impairments. The scripts are annotated to exemplify the use of the intervention guidelines. The manual includes a glossary defining key words and concepts used in the text.

The first draft of the manual was sent to 20 professionals who have worked with individuals with severe disabilities in various capacities (e.g., personnel trainers, teachers, researchers, speech therapists). Within the manual, questionnaires followed the end of each section asking the evaluator to rate the material on a 7-point Likert scale according to readability, comprehensiveness, and whether or not the content was novel. At the end of each of the three chapters, similar questions were asked also using the 7-point Likert scale to rate each chapter's potential usefulness to service providers, presentation of new ideas, and comprehensiveness. For example; "This chapter gave me new ideas for working with children who are nonsymbolic," was to be rated on a 7-point scale of strongly disagree to strongly agree. In order to determine the clarity of the information presented, the questionnaires for each section also included a list of comprehension questions that asked the evaluator to relay the content presented (e.g., What was the rationale presented for using a consistent structure in daily activities? and What reasons were given for the importance of incorporating choice into a curriculum for students with severe disabilities?) The accuracy of the evaluators' responses to these questions is being determined in the current evaluation.

In order to evaluate the organization and content of the manual as a whole, a final set of questions was included to determine its usefulness in intervention programs and its potential helpfulness to the evaluators in their current roles with individuals with severe disabilities. Additionally, the evaluators were asked to identify strengths and weaknesses in the manual and to include suggestions for improvement. Many evaluators provided general and specific comments as well as reactions to the text of the manual by writing within the text or in the margins. In addition, feedback was

elicited in response to open-ended questions such as, "What content was most interesting to you?" "What did you like least?" and "suggestions for change," that were included at the end of each section. These comments are being reviewed and synthesized so that the suggestions can be considered and integrated into the revised version of the manual.

In addition to the manual and its questionnaires, the evaluators also received a separate questionnaire which included demographic information, a personal skill section, and a philosophical orientation section. The first part of this questionnaire, the demographic section, identified the evaluators' professional role and length of time working with individuals with severe disabilities, in addition to previous roles they had held. They were also asked to provide the same information about professional roles held with individuals with other disabilities. The second part of this questionnaire asked evaluators to rate on a 7-point Likert scale (very poor to very good), their personal skill level in communicating with individuals with severe disabilities who are also nonsymbolic (e.g., How would you rate your interaction skills with students who are both severely multiple disabled and nonsymbolic [do not speak, use sign language, or use symbol boards]?). The last section included a list of 24 questions aimed at identifying the evaluator's philosophical viewpoint of teaching and orientation to learning. Questions reflected a behavioral, cognitive, maturational orientation, or a combination of these. For example, "Learning is facilitated when the child's level of cognitive competence matches the kinds of experiences available," and "Learning is characterized by stimuli, reinforcers, and punishers in interactions with one's environment." Answers were on a 7-point Likert scale from strongly agree to strongly disagree.

Presently, all the feedback from this field review is being analyzed with a computer package (SPSS-X) to obtain descriptive and inferential data analyses. Also, qualitative analysis is being performed on the abundant comments evaluators provided. The analysis of the Likert-scale questions at the end of each section, chapter, and the entire manual will be compared with answers in the Personal Skills and Philosophical questionnaire to determine any relationships. Some general research questions that will be evaluated include the following: What were the roles of evaluators working with individuals who are nonsymbolic and what is their rating of their own personal skills in communicating with these individuals? What is the relationship between the evaluator's rating of specific questions or content in the manual and their philosophical orientation? and What is the relationship between the evaluator's role with individuals with severe disabilities and their evaluation of the manual's comprehensiveness and usefulness?

General response from evaluators indicate that the manual, Enhancing interactions between service providers and individuals who are severely multiply disabled: Strategies for developing nonsymbolic communication (Siegel-Causey & Guess, in press) has much potential for building communication with service providers and individuals who are severely disabled and will be an extremely valuable contribution to the field.

Summary

Empirical data from the research study at the University of Kansas, the development of reliable assessment codes, and the compilation of intervention guidelines in the curriculum manual (Siegel-Causey & Guess, in press) may provide important information on facilitation of nonsymbolic communication. The information reviewed in this manuscript provides evidence of the interrelationships of the primary caregiver and the infant in the acquisition of nonsymbolic communication. The foundation of communication acquisition begins at the nonsymbolic level as infants or young children with dual sensory impairments learn to communicate with their bodies, eyes, gestures, and vocal sounds. It is recognized that individuals who communicate in a nonsymbolic

manner (without words, signs, graphic symbols) need effective means of expressing their likes and dislikes, to protest, to make choices and requests, and to initiate and terminate interactions. The usual manner in which such communication occurs is through the individual's existing movements and behaviors. Unfortunately, despite the importance of these behaviors for immediate communication exchanges and in the acquisition of refined communication skills, there are few measurement tools or training procedures available that integrate the repertoires of nonsymbolic children into intervention programs. Consequently, it is vitally important that the research at the University of Kansas and other consortium sites in the Communication Skills Center has addressed these issues. Moreover, this manuscript provides a detailed review of nonsymbolic intervention between infants and caregivers. Effective intervention strategies must incorporate the variables identified from the normal infant literature including (a) caregiver sensitivity to visual, gestural, and vocal displays of the prelinguistic, nonsymbolic child; (b) caregiver displays of visual, gestural, and vocal behaviors; (c) establishment of reciprocal exchanges; (d) recognition of communicative opportunities within daily routines; and (e) caregiver structuring of interchanges by displaying sensitivity, timing, and contingent behaviors. It is essential that service providers recognize the foundation of early nonsymbolic development. They must learn the importance of the many variables that affect communication development in the child with dual sensory impairments or severe disabilities. By doing so, a context will be provided in which that child can reach his or her maximum potential.

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VL Mother-Child Interaction and the Development of Preverbal Communication

by

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The study of language development in children has broadened within the last decade to include prelinguistic discourse. Infants communicate before they talk and this ability evolves over the first year of life (Bates, 1976, 1979; Bruner, 1975; Bullowa, 1979; Dore, 1974, 1983; Ryan, 1974; Sugarman, 1984). Little is known, however, about this process in normal children, and much less is known for those born with dual sensory impairments. This is especially true of our understanding of the transitions and patterns that occur during the emergence of preverbal communication over the first year and a half of life and the relationship of this period to linguistic communication. Based upon the evidence that is currently available, achievements of the prelanguage period seem to influence directly the child's ability to communicate through primarily verbal means. Genetic predisposition, cognitive constructions, and social interaction are among the processes that are presumed to influence the development of language. The relationships of these processes to the concepts of innate language structures as described by Chomsky or the role of sensorimotor intelligence as described by Piaget (Piatelli-Palmarini, 1980) have not been defined for the prelinguistic period. Piaget contended that the structural aspects of the stages within the sensorimotor period of intelligence provide the basis for all later developments including language. However, this does not seem sufficient to account for all the "phenomena of language that demand explanation" (1954, p. 36). There are parallels, though, between sensorimotor action patterns and prelanguage development. The interaction of the infant with its caregivers is presumed to be a particularly important environmental influence. However, little is known about the interactional dynamics between caregivers and their deaf-blind infants and young children and whether specific parameters of the relationship contribute to or interfere with the rate of language development achieved by the deaf-blind child.

Communication may be defined simply as one organism having an effect on another. Brazelton (1973) and Schaffer (1979) believe that communication begins at birth because the normal infant is genetically programmed to participate in social interaction. This view is reinforced by the finding that infants as young as 72 hours have the capacity for facial imitation (Meltzoff & Moore, 1983a, 1983b). In the first months, the infant enlists the adult's aid as a mediator because control of physiological state transitions from sleep to alert and from distress and crying to alert is not voluntary (Als, Lester, & Brazelton, 1979). Although mutual contingencies come into play, the infant's behavior during this period is not intentionally communicative nor is it meant to affect the caregiver in any way. This is illustrated in Kaye's (1982c; Kaye & Wells, 1980) study of the burst-pause sucking pattern that human newborns demonstrate during feeding. The infant seems to pause about every 10 seconds while sucking on the nipple. This pause, in turn, stimulates the caregiver to jiggle the infant for a second or two which, in turn, causes a resumption of the sucking behavior. Kaye feels that this burst-pause behavior pattern is an important phenomenon:

It serves no other function than to get the mother involved in the feeding . . . and by making the mother and infant tend to take turns, the pauses and her effect upon them contribute to the mother's illusion that she and the baby are communicating, and they establish a precedent for using the basic alternation of turns in nonverbal interactions with the young infant

and despite the dialogue-like exchange, the only real accommodation is on the part of the mother. The infant's contribution is a self-regulating mechanism of some kind which happens to be preadapted to just the sort of intervention human mothers will make (1982c, p. 188).

That this pattern of turn taking is unique to humans supports speculation that it plays an important role in the early stages of prelingual communication.

The behavior of the mother during the feeding episode describes a second characteristic of communication; specifically, the inference of meaning in another's behavior. The infant's pauses between sucks has a communicative effect upon the mother who interprets and reacts to the infant's behavior as if communication were occurring. In a study of individual differences in mother-infant dyads, Bell and Ainsworth (1972) found that mothers who consistently and contingently respond to their young infant's cries as if they are signals requesting proximity and contact have infants who develop a differentiated repertoire of noncrying modes of communication later in the first year. This stage, often described as the period of "affective communication" (Adamson & Bakeman, 1982), seems to culminate at 6 months of age when infants begin to use adults as agents to achieve their goals. The second half of the first year marks the emergence of the third characteristic of communication; specifically, the intention to act on objects as well as to participate in the social system (Harding, 1983).

The focus of this chapter is on the evolution of the mother-infant relationship as a communicative system. Interactional opportunities as they occur within the mother-infant dyad and contribute to the development of a dialogue between infant and caregiver are reviewed in the first section of this paper. The interplay of affect and intention (social development) during the first 6 months is described. This is followed by a description of the development of intentional communication during the second semester of the first year. Notwithstanding our current inability to conceptualize systematically how the infant develops the ability to reference objects within interactive exchanges, this skill does not appear *de novo*, but relates developmentally to earlier forms of communication, particularly those originating from face-to-face interactions with adults. In the second section the influence of child and adult endowments is explored, as well as their effects on the communicative episodes each is able to construct. Additional dimensions to the study of communication development are introduced through an examination of research studies conducted with young children with handicaps or considered to be at risk. These studies also provide the context for the third section of this paper which describes the theoretical framework and observational methodology we are using to examine the development of intentional signaling in infants with deaf-blindness and young children-caregiver dyads.

Interactional Opportunities and Communication Development

Early Interactions

The communicative interactions of infants and their caregivers while they are engaged in face-to-face interactions during the first 6 months of life have been the focus of a great deal of research in recent years. The infant appears to be predisposed to gaze at the caregiver's face (Fogel, 1982). This predisposition is reinforced by the finding that the ability to focus clearly is established by 6 weeks of age. In addition to gaze, the face-to-face paradigm elicits other orienting behaviors including attending to the high-pitched tone of the mother's voice as well as to the contours of her face. Infants possess attributes such as smiling and vocalizing in addition to gaze that attract and maintain adult interest and interaction (Schaffer, 1977). The mother behaves during

the infant's first months as if she were engaged in a true "dialogue." Newson (1978), among others, contends that the "desire to establish a degree of shared understanding with her baby is normally a powerful motive for the mother. She treats him from birth as a person who can be credited with feelings, desires, intentions, etc., and looks for confirmation that he will relate to her in a person-like way" (p. 37). Other investigators (Fogel, 1977; Malatesta & Haviland, 1982; Stern, Beebe, Jaffe, & Bennett, 1977; Tronick, Als, & Adamson, 1979) have also noted the significance of the infant's facial expressions and smiles. Mothers treat these expressions as turns in a conversation and respond to them verbally as well as physically through exaggerated facial expressions and body movements.

In studies of early face-to-face play, gaze regulations by the infant establish the cyclical framework of the interactions. Mothers, in turn, become adept at modulating their behavior in response to subtle changes in infant behaviors by matching frequency, tone, and intensity to conform to these visual and motor behaviors. Mothers maintain almost steady eye contact with the infant, and mutual sharing of expressions occurs during phases in which the infant gazes at the caregiver. In longitudinal filming of face-to-face play in five dyads when the infants were 6, 13, and 26 weeks of age, Brazelton, Koslowski, and Main (1974) found that this pattern of alternate cycling persists throughout the period. The authors question the possibility of a relationship between the smoothness of cycling in earlier sessions with the extent the infant's attention to the mother increases over the 5-month span. Stern (1974; Stern et al., 1977) describes the repetitiveness of mothers' kinesic acts and vocalizations as specially suited to maintain the infant's attention during arousal states. Two kinds of repetition are distinguished: "content runs" in which an act or message is clustered into smaller time blocks and repeated two or more times with longer pauses between them; and "temporal runs" in which different acts or messages occur, but each receives equal stress. Stern and his colleagues (Stern, Hofer, Haft, & Dore, 1985) also find that mothers match their infant's state to create an attunement in the same modality, cross-modally, or by mixing modalities. As an example, when the infant vocalizes, the caregiver can attune by matching vocalization with vocalization (intramodal), or with a gesture (cross-modal), or with both (mixed-modal). The investigators felt that these mixed-modal changes or natural adaptations on the part of the caregiver are optimal for holding the infant's attention and are part of a complex empathetic process, which they called "affect attunement." Caregivers who participated in this study were asked to indicate whether they were fully aware, partially aware, or unaware of their attuning behavior at the time of its occurrence. It is interesting to note that 31.3% were fully aware, 29.5% were partially aware, and 38.2% were completely unaware of their attuning behavior at the time of performance (p. 261). Trevarthen (1977) has shown that in contrast to adult-adult discourse, mothers automatically modify their behavior to match the infant's perceptual and communicative level by using "baby talk." Patterned body movements and touch are combined with nonsense syllables and singing to create voice games with many repeating sequences "as in simple music" (p. 336).

In an earlier study Stern, Spieker, and MacKain (1982) focused on the pitch contours of maternal speech to infants at 2, 4, and 6 months of age in order to determine the interrelationships of pitch contour and sentence type to interactional and motivational contexts as they occur within the dyad. Mothers use a high, rising pitch contour which appears to serve the communicative function of capturing the infant's attention when the infant averts gaze and demonstrates neutral affect. Stern as well as Ryan (1978) feel the use of the rise contour with young infants is similar to the vocal signal used by mothers as a request to the year-old child to join in and contribute vocally to the conversation. Mothers use a "bell-shaped" or "sinusoidal" pitch contour that appears to serve the communicative function of maintaining visual gaze and positive affect when

the infant is engaged in interactions with the caregiver. Papousek and Papousek (1977) contend that the intonation contours of "motherese" may activate orienting responses or defensive behaviors directly in the infant. These contours elicit affective displays of pleasure or distress, suggesting a biological as well as experiential basis for the infant's response to the mother. On preliminary examination, and with the exception of declaratives, sentence types used with young infants are spoken with characteristic contours that appear to parallel adult-adult contouring (Stern et al., 1982, p. 734).

Infants only a few weeks old have been observed to display all of the facial expressions identified in the adult repertoire (Charlesworth & Kreutzer, 1973; Oster & Ekman, 1977). Oster (1978) has shown that premature as well as full-term infants display well defined and highly discriminable facial movements. Izard (1978) identified the expressions of interest, joy, physical distress, and disgust during the neonatal period. Smiling, a species-specific social signal that indicates both pleasure and "readiness to communicate" (Trevvarthen, 1977) is clearly in evidence by the time the infant is 2 months old. The "coo" expression is also visible by the infant's second month. Certain articulated hand and finger movements including pointing, waving, grasping, clenching, and finger-thumb closing have also been observed in the young infant (Trevvarthen, 1977). Although infants lack the muscle control needed to articulate speech at this age, all of the other elements of human communication including facial expression, hand gestures or movements, and vocalization are evident by 2 months of age. Our knowledge remains limited concerning the co-occurrence of one behavior with another, however, the correlation of these behaviors with visual gaze, and the ontogenesis of these behaviors to their adult form seem related. Nevertheless a number of consistencies about the behavior of 2-month-old infants can be demonstrated; specifically, it is known that children at this age display different movement patterns and different organization of the same movements in diverse contexts.

In a study involving face-to-face interaction with the mother, Fogel (1979) found that the infant's motor movements were smooth, and incorporated hand grasping and pointing at the mother. In contrast, during interactions with a peer, motor movements were visibly grosser, and an arm instead of a finger was thrust forward. In addition, the infant's entire body was thrust forward, and intense gazing at the other infant accompanied this movement. In another study, Fogel (1982) compared mother-stranger-leave-taking behavior among 20 infants who were 2-month-olds. Infants were more likely to cry, reach and look at the door after the mother left the room. In contrast, stereotypic movements of the mouth and signs of anxiety such as yawning and shielding, but without crying, were demonstrated when the stranger left the room. The infants were noticeably distressed by the termination of the interaction with the mother. Ainsworth (1980) also observed this behavior in 2-month-old infants. It is not clear, though, whether the distress response demonstrated by the infants was elicited by the situation itself or can be construed as an early sign of preference for or recognition of "mother" as a distinct person. In a followup to the study (Fogel, 1982), the stranger was instructed to play with the infant for 10 minutes with the mother present. There were no differential responses between absence of mother or stranger in this circumstance.

The infant also displays different movements in response to the mother's behavior when she interacts normally, but then assumes a "still-face" posture with the infant. During this procedure, the mother is asked to remain silent while looking at her infant with a blank or "still" face. The silent unresponsive face of the mother has an immediate and predictable effect on the infant who repeatedly looks "inquisitively" at the mother as if she were not behaving "naturally." The infant then tries to regain the adult's attention by vocalizing and reaching out to the mother for a response. After numerous

attempts, the infant's failure to accomplish the task causes gaze aversion and physical withdrawal with the infant shrinking down into the seat or covering his face. The intensity of the infant's response to this situation increases if the mother prolongs the still-face expression (Trevvarthen, 1977; Tronick, Als, Adamson, Wise, & Brazelton, 1978). Fogel (1981) replicated this finding and, although the infants reduced the amount of gazing and smiling to the still-face, there was an increase in "pointing at mother" during this condition. Fogel was not able to interpret these findings because it is not clear what contextual dimensions the infants were responding to or what purpose this gesture served in this context (p. 39). Cohn and Tronick (1983) have shown that mothers simulating depressed affects provoke distress in their infants. Additionally, the infants remain distressed even after the mothers resume their normal behavior.

The infant's response to the still-face paradigm raises important questions about the relationship of infant affect to other developmental processes. Sroufe (1979) suggests that infants become upset by the still-face posture because it is a violation of expectancy; that is, the infant has learned that gazing at the caregiver results in her reacting in a certain manner. When the infant receives a distorted response from the mother, expectations are violated and this may lead to a state of disequilibrium. Within a Piagetian framework, the infant is unable to assimilate the discrepant event and as a result reacts with distress to the event. The emotions displayed by the infant during the still-face paradigm are seen as reflecting changes in the infant's level of arousal following the tension/evaluation response model of Sroufe and Waters (1976; Sroufe, 1979). Tension is defined as a psychological construct in that physiological processes are combined with the cognitive-evaluative components of experience. Translated into the still-face paradigm, the directions of prior arousal, contingency, and prior interactive experiences with the mother/caregiver all contribute to how the infant behaves when exposed to the mother in this context.

The infant's attentiveness to the mother can be captured if the mother is initially nonexpressive, but uses other modalities such as touching, postural changes, and physical movement (i.e., bouncing to attract the infant's attention). Once the infant orients to the mother's face and is "greeted" with a smile or exaggerated facial expression, the infant's attention is promoted and maintained by the mother's increasing use of facial and vocal expressiveness during the interaction. This, in turn, stimulates facial and vocal responsiveness in the infant. In a study of early mother-infant interaction, Fogel (1977) found that the relevant units in this interaction consist of maternal "on" and "off" phases that seem to interdigitate with the "on" and "off" phases of infant attention described by Brazelton, Koslowski, and Main (1974) and Trevvarthen (1977). These phases are discrete events that are dependent on the infant's attentiveness. Infant expressive behaviors, though, do not cluster into an organized pattern until the infant is 3 months old. Up until this time, smiles, vocalization, and wide-mouthed expressions and their proximity to one another are randomly distributed in time (Kaye & Fogel, 1980). Facial expression becomes organized during a process of face-to-face interactions that incorporates mutual imitation. By 26 weeks, this results in the infant's facial expressions clustering into dialogue-like turns with the mother. The infant's cycles of attention parallel infant expressive behaviors in that they too are randomly distributed and are not a function of time. This is true for duration also.

The cyclical nature of the infant's attention and excitement with the mother's displays has an internal rhythm of its own. However, the cycles themselves are not entrained temporally, and neither infant nor mother can anticipate one another's behavior on the basis of elapsed time between episodes. The infant's attention increases and doubles by the time the infant reaches 26 weeks of age; yet, interactive cycles with the mother still remain random and independent of time as far as their predictability.

Infant vocalizations within an adult dialogue follow the same process, and individual turns fluctuate randomly around the mean length of turn, eliminating time as a cue for predicting when to "take the floor" (Kaye, 1982c, p. 191).

The mother adapts and adjusts her behaviors to the infant's displays, to produce an alternation as in conversational turn taking. In order to facilitate the process and avoid great periods of silence, the mother introduces synchronicity into her play with the infant. Kaye (1982c) describes two principal forms of synchrony: "back channels" in which the infant's expressions are mirrored or verbal and physical gestures are unobtrusively introduced by the mother to lengthen the interaction with the infant, and "chorusing" in which the mother coaxes the infant to engage in simultaneous vocal and nonvocal behaviors also as a strategy to prolong the interaction (Schaffer, Collis, & Parsons, 1977; Stern, 1977). Stern, Beebe, Jaffe, and Bennett (1977) describe a "coactional" pattern, in which mother and infant vocalize simultaneously as the predominate mode of communication when the infant is 3 to 4 months old. The coactional mode serves to strengthen the mother-infant relationship, while there is a gradual shift to the predominantly alternating pattern observed in adult dialogue sometime after this point. Anderson, Vietze, and Dokecki (1977) found that in a free-play situation, 3-month-old infants and their mothers were more likely to vocalize if the other partner was vocalizing. However, mothers were more likely to vocalize regardless of the infant's behavior, and infants were more likely to stop vocalizing regardless of the mother's behavior.

To summarize, mothers seem to respond vocally whenever the infant does anything that can be interpreted as a turn in a conversation. Failing this, the alternative is to coax a conversation from the infant. Imitation or mimicking the infant's facial expressions and the use of vocalizations seem to be unconscious strategies that mothers employ to strengthen meshing or co-action with the infant (Malatesta & Haviland, 1982). Bateson (1975, 1979) described a temporal organization between mothers and 2-month-old infants that she calls "protoconversations," meaning an alternating pattern of vocalizations between infants and mothers. A study of these sequences "established that the mother and infant were collaborating in a pattern of more or less alternating, nonoverlapping vocalization, the mother speaking brief sentences and the infant responding with coos and murmurs, together producing a brief joint performance similar to conversation" (1979, p. 65). Bateson distinguishes between utterances that are "responsive in a sustained sequence and others as trying to renew the exchange when it lagged" (p. 104). This seems to be similar to the concept of chorusing and back channels although Bateson, unlike the other investigators, finds that mother and infant rarely interrupt one another.

By the fifth or sixth month of age, the system of affective reciprocity seems to be consolidated, and infants and their mothers are ready to move into a new phase of their relationship (Kaye & Fogel, 1980). At this time, infant and mother enter into face-to-face interactions smoothly and quickly to share messages about "how I feel and how I feel about your feelings" (Trevvarthen, 1977). Trevvarthen (1977), describes this as the stage of "primary intersubjectivity." The medium and the message are entrained and the infant does not differentiate self from mother during this stage. The enface situation, however, becomes increasingly difficult to maintain beginning at about 26 weeks because the infant begins to look away from the mother and objects while the mother herself wants to incorporate objects into her play interactions with the infant (Kaye & Fogel, 1980; Trevvarthen & Hubley, 1978). Infants at this age appear to go through a phase where they are unable to attend to the mother if her actions are directed towards mutual attention to an object. The result is that the infant deflects gaze away from both the object and caregiver (Clark, 1978; Trevvarthen, 1977). The infant acquires greater internal organization by 6 months of age, and it is at this point

that the potential for referencing emerges as objects begin to be incorporated into the infant's world. This phase of development is discussed next.

Affect, Reference, and Intention

Face-to-face play dominates the interactions of mothers and infants during the first 6 months of age. During this period, mothers assign meaning to the infant's actions, and their behavior then has a communicative effect on the mother. This action has been defined by the speech-act theorist J. L. Austin (1962) as perlocutionary, that is, one partner interprets the "acts" and reacts as if the behavior of the other partner were intentional. Bates, Camaioni, and Volterra (1975) classify the infant's earliest sounds within the speech act theory as perlocutionary because the mother reacts to these utterances as if they were communicative signals even though there is no evidence to support the intentionality of the infant's vocalizations. The second kind of speech act defined by Austin is the illocutionary act that is recognized by both speaker and partner as communicative. Stated otherwise, vocalizations and/or gestures have the force to communicate requests or other communicative functions. The illocutionary stage of communication development is achieved when vocalization is used by the infant to direct adult attention to objects and events. Golinkoff (1983a) described the transition between perlocutionary and illocutionary stages as the point that differentiates interactional communication from instrumental communication. The latter refers to the stage where the infant uses communication to obtain a goal other than social interaction with the adult. This is a gradual process that ends when the infant begins to use words referentially.

Intentional behavior begins to emerge when the infant is between 6 and 11 months old, coinciding with Piaget's Stage 3 of sensorimotor intelligence. The transition from preintentional to intentional communication has been observed when the infant is around 9 to 10 months old (Bates et al., 1975; Harding & Golinkoff, 1979). The role of affect begins to change over this period from primary organizer of reciprocal interactions where affective displays are the "topic" of the conversation to a "supportive" role in which affect is used to "comment" on the object world (Adamson & Bakeman, 1985). It is during this period that the connecting structure between cognitive anticipations and interpersonal affect emerges.

... by 9 months the infant is an emotional being. Now the subject-object relationship is primary. In a new way the meaning of the event for the infant is responsible for the effect. Thus, by about 9 months the infant laughs in anticipation of mother's return in peek-a-boo, rather than in response to the completed sequence. It is in the face of an obstacle blocking an intended act (a particular relationship and psychological investment). And it can experience threat in advance of noxious stimulation (fear). This is also the age at which surprise, as opposed to startle, appears Awareness has become anticipation. While in the second quarter the infant has motor anticipation based on well-established action sequences, by 9 months there is cognitive anticipation. (Sroufe, 1979, p. 488).

Harding's (1983) study of communication during this transition period provides further insight. Mothers appear to react consistently to eye contact as a communicative behavior in 6-month-olds, especially when combined with vocalization. Vocalization by itself does not appear to have a communicative effect upon the mother, and mothers of infants at this age also appear to ignore global body movements as communicative bids. As soon as eye contact does occur, mothers react with comments and actions "as

if in response to intentional communication" (p. 106). These behaviors are not coordinated intentionally by the infant at this age and their "coincidental co-occurrence" supports the thesis that the mother's inference of intent to the infant's actions precedes and contributes to the development of intentional communication (Harding, 1983; Newson, 1977). Mothers in the Harding study tended to respond to their infants at ages 6 and 9 months by combining verbal comments with an action. In addition, all of the mothers engaged in behaviors described as "instructive" by Ryan (1974) by either monitoring the infant's behavior or directing the infant's attention. There is variability in the content, but mothers either label or describe the infant's actions aloud during joint interactions. Mothers also initiate at least half of the conversational interactions with infants in this age group. Harding and Golinkoff's (1979) study of 8- to 12-month-olds focuses on the communicative attempts of this age group as they learn to use adults as agents to achieve their goals. Perlocutionary infants rarely direct vocalization at their mothers because they do not seem to understand the assistive role the mother can play as an "agent" who can help them to obtain objects.

Two interrelated causal abilities emerge during this period that allow infants to use vocalizations intentionally. First, the infant becomes able to coordinate vocalizations with other behaviors; specifically, eye contact or gestures are articulated in such a way that the mother responds to them as signal to act. The infant then begins to recognize that this sequence of behaviors (means), can cause an event to occur (ends). The second ability to emerge is the infant's growing autonomy as a person separate from the mother. This allows the infant to contact the mother when an object is desired because the infant recognizes the mother's potential as an agent who can act on his or her behalf. These cognitive achievements emerge during Piaget's Stage 5 in the development of causality (Piaget, 1954). Even though Piaget does not describe prelinguistic communicative development, he does state that it is during Stage 5 that the infant learns to use the adult as a tool to accomplish goals; therefore, the infant's vocalizations become the means through which the infant signals the mother. These steps are summarized in Harding's (1984) developmental model of communication in which she proposed the following:

Intention develops in a sequence of three components: (a) awareness of a goal; (b) development of a plan for achieving the goal; and (c) development of coordinated plans involving alternative plans and intermediary goals. A fourth component, persistence, is assumed to occur throughout the development of the other three, dependent on the level of behaviors available (p. 128).

The use of hand movements also helps to distinguish between the behaviors of the perlocutionary and illocutionary infant. The perlocutionary infant rarely uses pointing as a communicative gesture during play with objects, but resorts to banging, throwing, and pushing as a possible "primitive" means of making a toy work. In contrast, the illocutionary infant coordinates gestures such as pointing (Murphy, 1978; Murphy & Messer, 1977) with vocalizations as well as visual gaze with looking back and forth between the mother and the desired object. The mother, in turn, begins to both interpret and react most often to those behaviors that approximate conventional communicative actions of reaching, eye contact and vocalizing by reinforcing their use as communicative behaviors. During Piaget's Stage 4, when the infant's behaviors are directed towards instrumental achievement of a goal, the mother's behavior begins to "in repeated encounters . . . impart to the infant's actions a sense of coherence and goal directedness which they would not otherwise have" (Newson, 1978, p. 39). As the infant becomes more organized in interpreting the environment during Stage 5, the role of the mother in the achievement of goals is recognized by the infant.

The infant develops person-oriented and object-oriented, social-interactive patterns separately before coordinating them into socially focused vocalizations about a particular event. By about 13 months, the infant demonstrates mastery of many nonverbal forms of reference and at this point, begins to display early forms of verbal reference (Bates, 1979; Greenfield & Smith, 1976; Sugarman-Bell, 1978). This marks the beginning of the stage Austin describes as locutionary. However, even at this stage when the infant begins to utter sounds in contexts where nonverbal expressions have been formerly used, the intention of the message expressed by the infant still needs to be interpreted by the caregiver. As Ryan (1974) points out:

The child is using the same word to make several different utterances, on different occasions . . . and how, for instance, do we decide whether or not a child is using words to name, to comment on, to describe, to assert the existence of something, to request, to refuse, to point out related features for which the appropriate words are not known, to greet - plus all the other plausible functions that a child's utterances can be interpreted? (pp. 202, 204).

Summary

The research reviewed in this section focused on the interactional opportunities that occur within the context of the mother-infant dyad. This discussion helps us to understand the process through which the infant becomes an intentional partner in a social system. During the infant's first 6 months of life, affective displays mediate dyadic interactions by providing the signals to initiate, maintain, conclude, or even avoid engagement itself in the communicative process. Dyadic gaze and vocalization are not symmetrical during this stage and mothers spend more time looking at and vocalizing to their infants than is reciprocated by the infant. Even though the engagements of the mother and infant often have the appearance of a dialogue, the mother's behavior is actually directed at minimizing vocal overlap in order to maintain vocal alternation. The transition from mother-oriented to object-oriented behavior that begins when the infant is about 6 months old is neither simple nor well understood at this time. It is at this point, however, that the infant's cognitive construction of the world becomes a central theoretical construct (Harding, 1983). The mother continues to infer intention and to act consistently and contingently as the infant attempts to achieve goals, even though social interaction and communication are now dependent on the infant's cognitive level. As the infant's behavior becomes more organized, the mother continues to interpret the infant's behaviors as communicative, but her role becomes less generally presumptive and more specific as she structures or "scaffolds" the infant's efforts by structuring the environment. In essence, the mother's strategy seems to be devoted to getting the child to look, to point, and to vocalize at the right junctures in the dialogue exchanges between them (Bruner, 1978). As the infant progresses, mothers tend to "up the ante" (Bruner, 1978) by requiring the use of more competent forms of communication such as words to identify their intentions.

At this time, it seems reasonable to believe that a relationship exists between early infant responses and later reciprocal, conventionalized patterns of prelanguage social exchange. My views on this have been influenced by Kaye (1977, 1979) and Bruner (1977, 1978) who propose that a system of rules for social interaction is learned during mother-infant interactions. It is this system that serves as the basis for learning language.

Mother-Child Characteristics and Communication Development

Current arguments state that infants communicate before they talk. Moreover, the social routines and interactions that evolve within the context of conversation-like exchanges between the caregiver and the infant facilitate the communicative process (Bruner, 1977; Bullowa, 1979; Freedle & Lewis, 1977; Trevarthen & Hubley, 1978). The rules of communication including mutuality, turn taking, and commenting on one another's actions are learned during the first year of the infant's life (Collis & Schaffer, 1975; Kaye, 1977). The dynamics of this relationship are altered when the infant is born with sensory impairments that limit natural access to the behavioral modalities of mutual gaze, vocalizations, facial expressions, and gestures. However, communication is bi-directional by definition and the infant's, as well as the caregiver's, characteristics and attitudes influence the communicative process even when an infant is not physically impaired. This section reviews the influence of maternal and infant endowments and violations as they affect communication development during the prelanguage period.

The maintenance of mutual eye gaze during face-to-face interactions is a universal goal of caregivers in Western culture (Kaye, 1982b). The intensity of this behavior normally varies from dyad to dyad, and it is not unusual for violations to occur during face-to-face interactions. Cohn and Tronick (1982) define rule violation as the failure to act in a prescribed manner during a particular context. For example, placing the infant in a face-to-face position is a context marker for visual attention that serves as a signal to the infant that it is time to engage in joint play activities with the caregiver. Stern (1974) describes these rule violations as mismatching, but argues that they actually facilitate interactions because they provide an opportunity for instituting goal-correcting maneuvers. As we have seen in the still-face paradigm, infants avert their gaze when mothers violate the interactional context by not looking back at them, despite their repeated attempts to capture her attention. In a study with paradoxical results, Field (1979) asked mothers of normal and preterm infants to imitate only the infant's expressions and remain silent when the infant's gaze is averted. A marked difference was found in the way the two groups of infants respond to this situation. The normal infant's behaviors were similar to those seen in the still-face studies. Conversely, the preterm infants tended to spend more time gazing at their mother during the imitation procedure than during normal face-to-face interactions. The normal behavior of the mother appears to be too stimulating for the preterm infant's immature central nervous system to assimilate. The enface context serves as a signal for the preterm infant to avert visual gaze from the mother whereas the imitation procedure serves as a signal to gaze at the mother.

Cohn and Tronick (1982) also describe a second type of context violation that occurs when mothers express two conflicting messages with the timing of one response contingent upon the infant's response to the preceding message. Examples of this sequential-contingent violation can be found in the frame-by-frame analysis of early home movies of children who were later diagnosed as psychotic by Massie (1978c, 1982). One set of films describes the behaviors of a mother who becomes tense and evasive when her infant gazes at her. The infant becomes dejected and turns away from the mother who then responds to the infant in a superficially loving manner. The mother's second response denies the first rejecting message. This behavior places the infant in a "double bind" because the mother repeatedly violates the social context with the cues she signals to the infant. Another film study (1982) involves a 4-year-old whose mother seeks help because the child has failed to maintain eye contact with the mother beginning at 6 months of age. Films of mother and infant interacting when the infant was 4 months old reveal a pattern in which the mother consistently blocks the infant's smiles and visual attention by placing her cheek against the infant's cheek. When the dejected

infant turns away, the mother elicits her attention through touch and physical nuzzling. However, as soon as the infant begins to smile and gaze at the mother again, the mother re-blocks the advances by placing her cheek in the infant's visual path. The "depressed" infant turns away from the mother after the third failed attempt to gain reciprocity. We do not have enough information about the infant's behavior prior to 4 months of age to know if mother and infant ever achieved joint interactive cycles prior to the filmed episodes. Nevertheless, it is entirely possible that the mother's behavior may be an adaptation on her part to avoid feeling rejected by an infant who fails to return visual gaze during early infancy, a situation that may have been exacerbated by the infant's underlying affective disorder.

In another study of a clinical nature, Adamson, Als, Tronick, and Brazelton (1977) observed the interaction of a sighted infant of parents with blindness who were unable to establish eye contact or respond to the infant's visual cues. In addition, the mother had been blind from birth and her own facial expressions lacked animation and modulation. The infant maintained eye contact with sighted adults, but averted gaze away from her mother's "blank" face by turning her head away when held horizontally in the mother's arms. This response is not dissimilar to those of the infants observed in the still-face paradigm. With intervention, caretaking activities were structured to allow dyadic interaction to occur during such functions as bathing in order to provide a context for play activities. The incorporation of objects into mother-infant interactions after 6 months of age increased the context markers by providing opportunities for reciprocal play within the dyad.

The innate characteristics of many infants who are at risk or handicapped, such as their appearance, cry patterns, temperament, dampened or exaggerated response to stimulation, and possible inability to produce distinctive signals, contribute to the development of dysfunctional interaction patterns with the caregiver (Bridges & Cicchetti, 1982; Burlingham, 1974; Fraiberg, 1977; Sameroff & Chandler, 1975; Schlesinger & Meadow, 1972). The literature related to premature infants with very low birth weight indicates that many display greater irritability than full-term infants. Social responsiveness is affected as well because social smiling is reportedly delayed (Crnic, Ragozin, Greenberg, Robinson, & Basham, 1983; Field, 1982; Goldberg, Brachfeld, & Divitto, 1980; Ungerer & Sigman, 1983). The infant's dampened affect, irritability, and gaze aversion affects parental interactions. Mothers of premature infants spend less time engaged in face-to-face play, make less physical contact, and smile and touch their infants less. Even when the infant is 2 years old, they seem to be more emotionally withdrawn from their children than mothers of full-term infants (Bee et al., 1982; Crnic et al., 1983; Field, 1982; Goldberg et al., 1980; Malatesta, Grigoryer, Lamb, Jalbin, & Culver, 1986; Thoman et al., 1978; Ungerer & Sigman, 1983). Mothers of premature infants are also more likely to initiate or continue interactions even when inappropriate, despite the fact that the infant is less likely to assume an active role in these interactions (Bakeman & Brown, 1980; Field, 1979).

Mothers of handicapped infants have been found to decrease their response to infant crying and fretting over time, once they determine that their infant is "difficult" (Brooks-Gunn & Lewis, 1982). On the basis of observation (Appell, 1982), infants with deaf-blindness fall into two temperamental extremes of either chronic irritability or withdrawal, causing them to be regarded as "difficult" babies (Carey, 1970). Children's temperamental styles do change over time (Thomas, Chess, Birch, Hertzog, & Korn, 1964) and as observed among children with dual sensory impairments, differences often emerge as late as 5 and 6 years of age. These changes are speculated to be either secondary to cessation of the underlying disease process that caused the handicaps in the first place, or the emergence of new skills such as independent walking. However, it is not

known if these changes have positive impact on caregiver-child interactions because early feelings of helplessness may have become too reinforced over time to raise parental expectations.

This contention is illustrated in a study of 3-year-old children with deaf-blindness and their caregivers whose interactions were characterized by their lack of activity (Walker & Kirshman, 1981). Inactivity on the part of the children accounted for 50 percent of the play session. Social interaction between dyads composed of infants and caregivers without handicaps consists of sequences of repetition of a single behavior or patterns of behaviors. The mothers of the children with deaf-blindness appeared to be so uncertain about the effect of their actions on their children that their own behavior, in turn, lacked rhythm and predictability. In addition, the tactile modality did not soothe or provide comfort to these children, but provoked defensiveness and distress instead. The mothers continued to use this modality despite the children's continued distress. This behavior on the part of the mothers was interpreted by the authors as being "non-adaptive" (p. 26).

Infants with visual impairment have been characterized as fussier and less responsive in socially oriented interactions with their mothers (Rogers & Puchalski, 1984). Other studies of early dyadic interaction with these infants indicate that the loss of a sensory modality does not of itself necessarily affect the capacity of the infant and caregiver to generate and maintain communicative signals (Als, Tronick, & Brazelton, 1980; Fraiberg, 1974, 1979). As Fraiberg (1974) points out, though, infants with blindness smile to voice at the normal time, but this behavior diminishes gradually through lack of visual support. Input from social partners is necessary for the continued development and modulation of affect expression in these infants or they begin to appear to be affectively "impoverished" (Fraiberg, 1979). Mothers of infants with visual impairments are called upon to adapt to their infants by learning alternate strategies to establish and maintain cyclical interactions with them.

The caregivers in the study cited above (Als et al., 1980) learned to make "repeated efforts" during face-to-face interactions, to draw the infant into an optimal state, where "the negotiation process, by virtue of the sensory handicap, is more explicit, repetitive, and amplified for the blind infant" (p. 198). The mother learned to organize the infant's behavior to facilitate interactive cycles through the use of closer tactile contact such as holding the infant's hands and engaging in close-up continuous talking. In a later study when the same infant was almost 5 months old (Als, 1982), organization had become parallel, and mutual, orderly, and dyadic interactions were more synchronous. The infant progressed through the process of early organization at a pace similar to that of the infant without handicaps, but the range of "flexibility and differentiation at each stage was somewhat restricted, as if the lack of vision reduced the system by one channel for modulation, and it therefore had to economize on externalized ease and richness of communication" (p. 157).

Urwin (1984) also noted the difficulty infants with blindness experience when they attempt to evoke adult attention and interaction prior to the onset of speech. The three physically intact infants with blindness who participated in this longitudinal study, demonstrated restrictions in their early verbalization, even though intentional language emerged at the same age as for normal nonhandicapped peers. Further, Fraiberg (1977) learned from her observations of infants with blindness to read their hand movements. Specific movements appeared to be signals the infants were using to indicate the desire for social interaction with the caregiver. The infant has "in fact a differentiated vocabulary of motor sign in orientation of the head, and extended arms and hands" (p. 163). These signs, however, require an interpreter if they are going to

have communicative effect on the listener. Unfortunately only 20 of the mothers in the study independently noted their communicative significance. It is interesting to point out that all of the infants observed by Fraiberg articulated the same "sign system" to signal specific messages in similar contexts; that is, particular hand signs seem to be used universally by all blind infants to signal the same message. Other elicitors of social interaction with infants with visual impairment include the use of tactile and physical games as well as frequent repetition of familiar words. The use of explicit game routines combined with verbal exchanges to coordinate social and object schemes has been suggested as a strategy to stimulate communication development in visually impaired infants (Fraiberg, 1977; Rogow, 1983; Rowland, 1984; Urwin, 1978, 1984).

Mothers of infants with hearing impairment appear to dominate communicative exchanges and use less speech than mothers of infants without hearing impairment (Galenson, Kaplan, & Sherkow, 1983; Ling & Ling, 1976; Wedell-Monnig & Lumley, 1980). Mothers of infants with Down syndrome also appear to dominate and control communicative interactions in order to maintain a dialogue with their children. In an extensive study conducted with this latter population, Jones (1977, 1980) found that the infants with Down syndrome made far less eye contact with their mothers than the normal control group. As a result, there were significantly more failed communicative interactions among these dyads. Even though the infants vocalized at the same rate as the infants without handicaps, mothers did not respond contingently to their vocalizations. The vocalizations of infants with Down syndrome tended to consist of repetitive runs of the same consonant and vowel sounds. The mothers did not seem to know how to either reinforce or extend the infant's vocalizations into an interactive dialogue. The infants also did not do as much referential looking from mother to object as normal infants. They also interfered more often in turn-taking exchanges by either not leaving time for the mother to reply or by vocalizing with them.

A series of studies have attempted to characterize the manner in which mothers communicate with their young children with mental retardation. Interactions were found to be more directive and less frequent with responses unrelated to the children's communication (Cunningham, Reuller, Blackwell, & Deck, 1981). Eheart (1982) found that mothers of children with mental retardation initiate almost twice as many interactions than mothers of children without this condition. The children respond 56 percent of the time to their mother's initiations in contrast to the normal sample where the response rate is better than 75 percent. There is general agreement that the mothers of the children with mental retardation tend to dominate free-play interactions, are more directive, and interact with the child for longer periods of time when they, not the child, select the toy. The language that these mothers use has a lower mean length of utterance, is highly repetitive, contains more labels, and expresses fewer semantic relationships with more interrogative and imperative sentences used than that of mothers of children without mental retardation (Mahoney, 1983; Peterson & Sherrod, 1982; Rondal, 1978).

Even though the relationship of maternal speech, or "motherese," to later language outcome is not known (Shatz, 1984), the motherese used by mothers of children with mental retardation has been analyzed extensively. Compared with the language of mothers of children without retardation, the motherese used by mothers of children with mental retardation has been found to be more frequent, have a lower mean length of utterance (MLU), include fewer indefinite pronouns, conjunctions, and wh-questions, and contain more grammatically incomplete sentences and proportions of commands (Bruium, Rynder, & Turnure, 1974; Buckhalt, Rutherford, & Goldberg, 1978; Kogan, Winberger, & Bobbitt, 1969). In addition to studies of this nature, Mahoney, (1983, 1984) examined the communication between mothers and their children with mental retardation in order

to identify specific parameters of maternal communication that influence children's communication development. The results revealed a high correlation between maternal and child communicative response patterns. The critical variable appears to be the mother's communicative style and not the structural parameters of her speech. Mahoney classifies the mother according to her communicative style as a "Responder," "Attender," or "Ignorer." The communicative style of the "Responder" mother is more emotive and reactive to the child's interests while the "Attender" is more directive and focuses on teaching the child her own goals rather than expanding upon the child's actions or interests. The "Ignorer" mother seems insensitive to the child's signals even though her language is not significantly different from that of the "Responder" or "Attender." The style of the "Respond" mother appears to reinforce child behaviors that relate to the development of intentionality, the crucial first step in the development of language.

In summary, reciprocal affective interchanges form the initial basis and content of communicative exchanges between infants and their caregivers. These interactions are modulated by a host of complex and possibly interrelated variables that include the infant's birth status, gender, birth order, arousal state, and affective expressiveness. As we have seen, though, caregiver behavior and characteristics have an effect on the infant as demonstrated by the "still-face" studies. There is a transactional process occurring within the dyad with the infant's abilities determining, to some extent, the kinds of social and interactive behavior directed to him or her by the caregiver. This raises many questions. Caregivers of infants and young children considered to be at risk or handicapped appear to be more directive and controlling in their interactions than mothers of children without these conditions. Does this relate to the caregiver's need to be a "super instructor" (Stern, 1982) in reaction to the infant's deficits? Is it a result of imitating the behavior of professionals observed in early intervention programs (Mahoney & Finger, 1985)? Or does it relate back to the infant's constellation of handicaps and general functional level (Brooks-Gunn & Lewis, 1984)? Based on the available literature and our own experience, we conclude that maternal attempts at socialization with an infant with deaf-blindness may go less smoothly than with infants without handicaps. The infant with deaf-blindness attempts to respond often but may go unnoticed, leading to greater delay and deficits in the area of communication development.

Infants with Deaf-Blindness and Their Caregivers: Current Research

Although our knowledge of communication and language development in children without handicaps is increasing, little is known about this process in children with deaf-blindness. Current literature establishes that some quality of the infant-caregiver relationship mediates developmental outcome. However, a systematic description of how mothers respond to infants and young children with dual sensory impairment is not available. We lack information related to what aspects of this interaction facilitate communication and communication learning in specific contexts. Mothers of infants without handicaps appear to engage in face-to-face interaction when the infant is in an alert and attentive state. In addition, mothers encourage visual attention and time their facial expressiveness to match intervals when the infant's gaze is on their face. We have no idea how the capacity to engage in reciprocal affective interchanges even develops when the infant lacks intact visual and auditory systems, is usually fussy and irritable, and is either easily overstimulated or unresponsive. To compound these issues, many infants with dual sensory impairments are frail and sickly, requiring multiple hospitalizations for physical illness or surgery. There is also limited understanding of how these partners transform their early social interactions to new modes of communication in which they share topics of conversation about objects.

The purpose of the study being conducted at St. Luke's-Roosevelt Hospital Center in New York City is to assess the social interactive and communicative behaviors of caregivers and infants and young children who are known to have sensory impairments alone or in combination with cognitive, behavioral or physical deficits. Because the development of communication is a complex process, we will also examine child, adult and environmental factors that may also influence dyadic interaction patterns. To accomplish this, observational methodologies developed to assess transactions between normal infants and their caregivers combined with a format for analyzing maternal communicative style have been incorporated into the design of the study along with a number of instruments to measure child performance variables and adult circumstances. This approach provides qualitative information that will allow evaluation of the communicative process as it develops in deaf-blind infant-caregiver dyads. In addition, the design permits us to explore the relationship between the emergence of linguistic referencing to earlier forms of communication in children with deaf-blindness while comparing this process to what we know about normal infants and children. The presence of combined visual and auditory impairment, like prematurity as a condition, yields no single outcome because of the heterogeneity of the population. Variability in joint interactions with caregivers and acquisition of communicative behaviors in general is anticipated. However, we hope that the relatively large sample size for the study provides a data base of sufficient size to allow us to be able to formulate statements that can be generalized to the greater population of infants and children with deaf-blindness.

The development of communicative behavior and intentionality in deaf-blind infant-caregiver dyads is assessed using a face-to-face protocol. This paradigm is used because it maximizes the display of social and communicative interaction skills between child and caregiver. This approach is felt to be particularly powerful to use with infants with deaf-blindness because their responses are often difficult to read, equivocal and lack predictability. We are attempting to test the hypothesis that the essential skills needed for learning language develop systematically during mother-child dyadic behavior (Kaye, 1979). Microanalysis as the selected research methodology provides a mechanism for exploring the relationships among events that occur within these time locked units. A control group of caregivers and infants without handicaps is being used to address the following questions: (a) Are there differences in communicative behaviors (facial expression, gaze patterns, vocalizations) of normal infants and those with deaf-blindness? (b) Are there differences in the pattern of maternal contingent responses directed toward the signals of infants with deaf-blindness and infants without this condition either initially or as the child grows older? (c) Can interaction effects be identified as a result of participation in an early intervention program? (d) Can interaction effects be identified that relate to developmental gains and improved performance? (e) Can caregiver characteristics that facilitate communicative interactions be identified?

Communicative exchanges between subjects with deaf-blindness and their caregivers are observed in a laboratory setting that is separate from the early intervention program the infants and children attend. Caregiver and infant or young child are positioned to allow both partners to face each other at eye level. Infants are seated in a typical infant seat that is placed on a table top opposite the caregiver while larger children are seated in a built up chair that has a plexiglass tray fitted over it. Caregivers are given a set of age appropriate toys to use with their children; however, their use is optional. The adults are also told to talk to, touch, sing and play with their infants as they would at home. These videotaped sessions usually extend from 15 to 20 minutes in duration, depending on the comfort level of both child and caregiver. Two cameras, one focused on the caregiver, the other on the child, are located outside the room behind an adjacent observation room. In order to have a full face view of

each partner of the dyad without having a camera in the room itself, a mirror has been placed in the playroom at an angle that allows the camera to film a full view of either the seated infant or child. The output from the two cameras is split providing an enface view of both the caregiver from the waist up on one half of the screen and a full view of the child on the other half. High-resolution black-and-white cameras are used because facial expressions are more discernible in monochrome. The passage of real time is recorded onto the videotape film itself and does not appear on the television screen. A custom-built device, the EECO-VITSI time code generator, interfaces the recording device with the time codes and a microcomputer. The time code generator labels the exact time of a behavioral event as it is entered on the microcomputer keyboard. This system makes it possible to quantify (duration of time) as well as qualify (event by event) the affective and communicative behaviors displayed by each partner during interactions with one another.

Behavior coding is the critical link between conceptualization and methodology. The categorization system for child and caregiver, The Communication Case Study Analysis (Appell, 1986), incorporates behaviors that express affect and reference. The behaviors that are coded have been adapted from classification protocols reported in the social interaction literature while the categories are based on our own observations of infant and caregiver behaviors. Six child and adult behaviors are coded and include body position and movement, head orientation, direction of visual attention, facial expression, vocalizations and hand movements. A seventh child behavior, limb movements, has been optional because we are not sure how much more information it adds to an already extensive catalogue. However, not coding leg movements may cause us to lose valuable information about particular infant's communicative signals or positive and negative responses to caregiver initiations. Behaviors related to these variables have from 4 to 22 mutually exclusive possible response categories. We are attempting to be as precise as possible in our description of behaviors in order to recognize any movements or patterns that are or can be interpreted as communicative by either participant in the dyad. Hand movements are a good example in that gestures are an early form of nonsymbolic communication and behaviors such as reaching, holding, pulling, waving and pointing may convey to the caregiver the infant's desire to be held, need for assistance or desire to gain proximity. Some hand movements may be idiosyncratic, but when used consistently in combination with other movements, operate as a communicative signal to the caregiver. The basic flexibility of the system allows us to add descriptors under each category for each member of the dyad as new behaviors are observed.

The Communication Case Study Analysis also incorporates a format devised by Ekman and Friesen (1978) to describe emotions in adults as well as a scale designed by Mahoney and Petersen (1980) to describe adult language. The Facial Action Coding System (Ekman & Friesen, 1978) is an anatomically based measurement system whose basic units are discrete, minimally distinguishable actions of the facial muscles that are organized in "action units." Each unit is designated by a number code and a set of dynamic cues including the direction of movement and changes in the appearance of facial features and contours, including wrinkles and pouches. Six emotions are identified in the FACS Manual: surprise, fear, happiness, sadness, disgust and anger. At the present time, we have observed 7 additional emotions expressed by the caregivers in the study including: interest, wariness, annoyance, "ooo" (or coo face), neutral (no expression), anxiety and yawning (although this can be described as a behavior rather than as an emotion). The FCS system is also being used to code the affective expressions of the infants. Oster (Oster & Ekman, 1977; Oster, 1978) has been adapting the system to the infant's face and "Baby FACS" (unpublished manuscript) is being used to code the facial expressions of the sensory impaired young children in the study. The Maternal Language Scale (Mahoney & Petersen, 1980) classifies utterances in relation to adult

stimulation to elicit responses as well as adult responses to child communicative behavior. The scale has been modified and is being used as part of the study design because it provides a qualitative measure of maternal language usage as well as communicative style.

Preliminary findings from our investigation of deaf-blind infant-caregiver interactions corroborates some of the findings reported in the Walker and Kirshman study (1981) as well as those previously cited. The sample includes 23 deaf-blind child-caregiver dyads and 4 deaf-multihandicapped-child-caregiver dyads. As a group, the interactions of 18 of the 20 caregivers whose behavior has been coded to date, lacks rhythmicity, predictability and contingency. Our caregivers do not use the tactile modality as often as one would predict and there is surprisingly little physical contact or game playing with the young child. The interactions, however, are not characterized by inactivity on the part of the young child because most of the caregivers do not allow the infant sufficient time to explore one object before another one is rapidly presented. This happens even when the child is holding a toy in one hand and occurs with such regularity that the word "intrusive" best describes the caregiver's behavior during play interactions. The caregivers as a group, also rarely engage in face-to-face play, but focus visually on either the toy in the child's hand or on other toys, rather than the child's face or eye region. This has been observed in the deaf-caregiver dyads as well as the deaf-blind-caregiver dyads. It also appears that many of the communicative attempts of the children often go unnoticed by their caregivers. The affective expressions displayed by the caregivers demonstrate surprisingly little positive affect such as smiling, joy or happiness while emotions such as disgust, annoyance, wariness, anxiety and sadness predominate. There is also very little caregiver vocalization or imitation in response to the infant's vocalizations or facial expressions. It is interesting to note that the 3 caregivers who evidenced cyclical interactions within the dyad, have infants that were 5 and 7 months old at the time of initial videotaping. Caregiver behavior is to be analyzed in relation to child age in order to learn if caregivers who have older children are more emotionally withdrawn than the caregivers of the younger infants, or conversely, become more engaged as the child grows older and more competent.

Summary and Conclusions

The identification of patterns of adult communication with deaf-blind infants and of those variables that support cognitive and facilitate linguistic growth is a critical need in development of educational programs for this heterogeneous group of children. Our initial findings demonstrate that attempts at socialization with an infant who is deaf-blind violate all of the patterns of dyadic interaction observed between healthy mothers and healthy infants. Similar, but perhaps less flagrant behaviors have been seen all too frequently when special education teachers were observed in the same setting. Since these professionals as well as other related personnel appropriately serve as role models for the caregivers, it may be that well intentioned teaching practices exacerbate an already difficult problem. None of our infants were studied prior to exposure to the intervention program; therefore, no direct information is yet available toward measuring teacher roles in the process. In any event, the severity of the problem is alarming because of its profound implications. We consider it essential that all levels of the transactional process, including caregiver (parent as well as educator), child, and environment, be involved in the search for solutions.

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VII. The Play of Young Children Who Have Dual Sensory Impairments

by

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A cuddly little bear springs to life at the touch of a switch. Toy blocks are gradually transformed into imaginary superstructures and the simple pleasure of play brings squeals of delight from young children. Smiles of reminiscent understanding emerge on the faces of observing adults as they watch these children "work." Children's understanding of themselves and their world unfolds as they create whipped cream portraits or splash about in a toy sink. These simple pleasures inconspicuously encourage more complex abilities by providing opportunities for growth in cognitive, communicative, physical, and social skills.

Professionals concerned with the development of young children with handicapping conditions frequently find themselves devising complex individualized education programs (IEPs) to promote criterion-referenced skills across several domains. Typically supporting these programs are daily instructional schedules, often taped to classroom walls, reflecting an ambitious sequence of activities designed to encourage children to rehearse, experiment, and practice targeted skills. Usually the word "play" is imbedded in such schedules only in the phrase "free-play"—a period of time usually used for transitions from or into other activities. It is noteworthy that parents and teachers of children with severe handicaps, who dutifully provide discrete units of instruction, frequently remark, "My child can do this or that (i.e., a task) when she is motivated to do it." Berlyne (1965), Deci (1975), Musselwhite (1986), Neuman (1971), and Rubin, Fein, and Vandenberg (1983) cite motivation as a primary reason for including play in the child's daily educational activities. The child who is motivated to interact with persons/materials is obviously more cooperative and thus, more open to learning opportunities. Consequently, active participation in play activities can facilitate the optional integration of other sensory experiences. By doing so, it can foster the development of related skills, including cognition and communication abilities.

In this chapter we examine two aspects of play. First, we examine the concept of play and provide a functional definition of play that is most useful for our focus on developmentally young children with deaf-blindness and related disabilities. Second, we review recent literature as it relates to play for children who have various handicapping conditions, including deaf-blindness.

Defining Play

Play is an activity that is looked at in many different ways by different people. In this chapter we focus on play behaviors that are appropriate for the activities and pursuits of young children with handicaps. This parameter suggests that we attend to very simple forms of play, since more complex play patterns involving group activities and games with rules are generally beyond the abilities of the young child with deaf-blindness.

If asked to define play, most adults would offer an operational definition supported with personal examples. Small children quickly assimilate the word into their expanding vocabularies and begin using it to explain their present or desired activity. However, as Allen Gottfried (1985) reminds us, "Play is by no means a trivial and simple set of behaviors. It is a complex multidimensional sequence of behaviors that change

considerably in process and morphology, particularly during the early childhood years" (p. xvii). In short, play is difficult to define. Clearly, no single behavior is represented by this concept.

Play is often described in the literature by certain characteristics (Bruner, 1972; Garvey, 1977; Weisler & McCall, 1976). Fewell and Kaminski (in press) have identified four features of play. First, play is intrinsically motivated. Children play for no other reason than to play. It is an end unto itself. Second, play is spontaneous, and children engage in it freely and voluntarily. Third, the desire to play is self-generated and requires active participation by the child. Fourth, play must be enjoyable and enable the child to derive pleasure from situations that are positive and successful. It is important to note these four features particularly as they relate to children with sensory impairments, because they address the motivational aspects so important (and often lacking) in curricula developed for children with severe disabilities.

Other investigators conceptualize play according to the types of play behaviors children exhibit (Bronfenbrenner, 1979; Chance, 1979; Fenson, 1985; Garvey, 1977; Piaget, 1962; Wehman, 1979; Zelazo & Kearsley, 1980) (See Figure VII-1). These researchers describe play in terms of sequential taxonomies, and provide a variety of constructs that can be applied to play. A specific lexicon of play behaviors can be extracted from these taxonomies. Most of this terminology is used to describe nonsymbolic and symbolic experience that characterizes stages of the child's development. It is important for teachers/caregivers to understand the stages of development as represented by the child's play behaviors. Although a child may demonstrate great variability across these stages, recognizing those play skills that are least frequent or generalized will help to structure intervention activities.

Nonsymbolic play

Nonsymbolic play behaviors are characterized as sensory explorations or reflexive acts and are represented in the motor acts of newborn babies (Fenson, 1985; Piaget, 1962). Bates (1976) refers to these movements/communication abilities as perlocutionary acts, which correspond to Piaget's Stages I-IV. Various definitions are available to describe play, that share several common elements. In her review, Rich (1987) discussed several elements that are useful in our study of the play behaviors of young children who are deaf-blind. For example, Fenson (1985) begins by describing reflexive behaviors and exploration in newborn babies, then progresses to manipulative investigations and pretend play. These playful behaviors characterize the first 3 years of life and are appropriate for the limitations of this review. Several features of these early play acts are helpful in discussing the play of children with handicaps.

Exploration

Sensory explorations are included within our definition of play. Bruner (1972) described the exploratory activities of infants as practice behavioral subroutines that are subsequently integrated into more complex patterns of behavior. Belsky and Most (1981) provided a very helpful and enlightening study of exploration and play in infants that describes explicit characteristics of these behaviors. Specifically, they defined 12 sequential activities, ranging from simple mouthing of objects to double substitution, and charted the behavior of 40 infants on these 12 activities. Our understanding of children with serious impairments is enhanced through this study of exploration. Exploratory behaviors are considered early play behaviors and include undifferentiated mouthing, simple manipulation, and juxtaposition of objects. Other investigators distinguish between play and exploration (Fewell & Kaminski, in press). For example,

Figure VII-1

Comparison of Play Definitions

I. Presymbolic Stage

Chance (1979)	Fenson (1985)	Garvey (1977)	Piaget (1962)	Wehman (1979)	Zelazo & Kearsley (1980)
A. Physical play	A. Exploration	A. Play with motion and interaction	A. Sensorimotor play	A. Exploratory play	A. Stereotypical play
B. Manipulative play	B. Functional/relational behavior	B. Play with objects		B. Independent play	B. Relational play
				C. Parallel play	
				D. Associative play	
				E. Cooperative play	

II. Symbolic/Representational Stage

C. Symbolic play	C. Symbolic/representational behavior	C. Play with language	B. Symbolic play	F. Symbolic play	C. Functional play
D. Games		D. Play with social materials	C. Games with rules		
		E. Play with rules			
		F. Ritualized play			

Hutt (1979) contends that true play behaviors are exhibited only after the child is familiar with the physical and environmental properties of an object or situation. Immature play behaviors are thus characterized by repetitious and systematic acts as opposed to those that are varied and less predictable.

Functional/relational behavior

The functional use of objects is often included in a description of play, and these manipulations are often included in instructional plans for children with handicaps. When children use objects in functionally appropriate ways, the activity reflects the child's understanding of the object's purpose. This type of manipulation demonstrates a cognitive attainment and serves as precursor to representational behavior, even though the activity emerges as a nonsymbolic play behavior.

Symbolic/representational behaviors

Symbolic or representational play reflects the young child's growing freedom from the concrete, external world as well as the child's increasing use of abstract, internal, and socially shared symbols. Such play is intrinsically motivated, involves an element of pretense, and focuses on means rather than ends (Rubin et al., 1983). A young child who builds a house out of blocks or who takes the role of a doctor in treating a "sick" friend would be demonstrating this kind of play. This type of play corresponds to the higher levels of play described by the researchers in Figure VII-1.

The distinction between nonsymbolic and symbolic play emphasizes important differences in early cognitive and communication development. In cognitive development, for example, the earliest expressions of intelligent behavior occur at the level of concrete action. Over the first 8 months of their lives, infants show increasing control and flexibility in their adaptive behavior. They can see an attractive toy, grasp it, and act on it. At 8 to 12 months of age, increasing evidence of symbolic thought appears. Children begin playing with toys and objects in particular ways that distinguish that toy or object from others. They begin to use particular sounds to represent the toy, person, or object. By the end of their second year of life, children express intelligence through mental experimentation prior to action, rather than through trial-and-error behavior. Similarly, communication development begins at the level of concrete expressions (e.g., smiling, sobering) and gestures (e.g., visual following, lifting arms to be picked up). By the end of the first year, the child's differentiated cries and babblings are replaced by a more powerful and abstract mode of communication: words. Through these locutionary acts communication, like cognition, becomes characterized by increasingly complex symbolic representations.

For the purpose of this review, then, we consider play to be the spontaneous, pleasurable activities of children that begin as simple explorations and progress to the use of actions or words that convey particular meaning to others without necessitating the presence of concrete objects. Thus, play may involve an investigation of body parts, experimentation with vocalizations, or complex turn-taking interactions with others that involve the use of symbolic or abstract objects.

Characteristics of Play in Children with Handicapping Conditions

A large number of children with deaf-blindness have concomitant handicaps of mental retardation, physical or motor impairments, and other health impairments (Jensema, 1979). Given the complexity of this handicapping condition, these children's development significantly differs from that of peers without handicaps. Since play is viewed as a

reflection of a child's developmental abilities, there is stark contrast between the play of children without handicaps and children with deaf-blindness.

To enable handicapped children to play and to learn while enjoying play activities, it is helpful to have some understanding of how particular disabilities might affect a child's play. Because a sensory deficit has an impact quite different from a physical deficit, it will be helpful to review what is known about how play differs in children with various handicaps.

Children with developmental disabilities

Most reports comparing the play of children with and without handicaps are based on isolated studies and anecdotal observations. In the available studies, however, one important fact emerges repeatedly: Although each child with handicaps is unique, all share an impaired ability to explore and interact in their physical and social environments.

By and large, children with developmental disabilities are impaired in their ability to explore, interact with, and structure their personal environments. As a result, the development of their play is delayed. This point is illustrated in a study of preschool children with multiple handicaps (Gralewicz, 1973). The play of 10 children between the ages of 31 and 58 months was studied. This group included five children with cerebral palsy, three with mental retardation, one with rubella syndrome, and one with autism. Their play was compared to the play of 11 children without handicaps. The children in both groups were matched for age, number of siblings, and number of adult relatives living within a 30-mile radius. The results indicated that the children with multiple handicaps spent less time in general play activities than children with no apparent handicaps, and that they spent more time on personal care and therapy. The two groups spent equal time playing alone. The children without handicaps spent more total time playing and had more playmates.

The strong relationship between symbolic play and verbal/cognitive functioning appears in studies that focus on the play of children with mental retardation. Odom (1981) used both verbal and nonverbal measures to assess mental age in preschoolers with mental retardation and preschoolers with no apparent cognitive handicaps. The data on play as observed and coded in the two groups showed a direct relationship between level of play and developmental level. The correlation between the Parten Scale of Social Participation and the Denver Developmental Screening Test (DDST) was .63; the correlation between the Smilansky Scale of Cognitive Play and the DDST was .81. Although these correlations were not unitary (perfect), there was a strong positive relationship between both the Parten and the Smilansky Scales and performance on the DDST, which is a measure of general developmental functioning. Both the Parten and the Smilansky scales, even though measuring levels of play, provided important information concerning the child's general level of development. In a related article, Sigman and Ungerer (1981) found that young children with mental retardation, matched for mental age of about 2 years with young children functioning at expected age level, showed similar play behaviors. Differences and similarities in language/cognitive skills (as reflected in mental age) were reflected in differences and similarities in level of play.

Findings consistent with these investigations appear in studies of children with Down syndrome, as well (Hill & McCune-Nicolich, 1981). Differences in levels of play within the population with developmental disabilities are correlated strongly with mental age and language comprehension. A study that demonstrated this point (Wing, Gould, Yeates, & Brierly, 1977) examined 108 children who were classified as having mental retardation, autism, psychosis, or severe language disorders. The researchers were

particularly interested in how stereotyped play might be related to mental ability. The investigators classified play according to three levels.

1. No symbolic play - toys or other objects were used in repetitive manipulation, if at all, regardless of what they represented.
2. Stereotyped play - toys were used symbolically or had other pretend qualities but with a very narrow range of use and with much repetitious behavior. Stereotyped play did not vary in different social settings and was not modified based on the suggestions of other children.
3. Symbolic (at the lowest level) - an object was used to represent something else.

Children's nonverbal mental age and language comprehension ages were derived using a variety of measures: the Bayley Scales of Infant Development, Merrill-Palmer Scale of Mental Tests, Wechsler Intelligence Scale for Children, Reynell Developmental Language Scales, and Illinois Test of Psycholinguistic Abilities. All but one of the children who engaged in stereotyped play ($n = 23$) had nonverbal mental ages of 20 months or above. Only three children whose play was at a stereotyped level had language comprehension ages below 20 months. This group included four children with the complete autistic syndrome. Another seven had marked abnormalities of language development; for example, three had echolalia. All of the children in this study who demonstrated symbolic play ($n = 23$) had nonverbal mental ages and language comprehension scores of 20 months or more. Over three-quarters of the children with Down syndrome in the study were in this group, whereas no child with the complete autistic syndrome was considered to be in this category. Of the children who demonstrated only nonsymbolic play ($n = 11$), all nonverbal mental ages were over 20 months, but nine of these children had language comprehension scores below 20 months. The two remaining children who engaged in nonsymbolic play and whose nonverbal mental age and language comprehension was over 20 months were both considered to have autism. The absence of symbolic play was closely linked to the presence of autism, and true symbolic play was not seen in children with full autistic syndrome. These low levels of play exhibited by children with autism have been reported elsewhere as well (Riquet, Taylor, Benaroya, & Klein, 1981), and seem best explained by deficits in concrete thinking, pervasive language problems, and lack of interest in the environment, all characteristics of these children.

It appears that the play of children with mental retardation develops in a pattern that is consistent with the play of normally developing children. Their play, like their mental ability, though, is considerably less developed for their chronological age. Specifically, the play that they exhibit appears to be on an age level that is consistent with their mental age. Autism, on the other hand, appears to involve an organic deficit in symbolic functioning and interferes with language development.

Children with language impairments

Strong evidence concerning the relationship between language and play comes from studies of children with impaired language. In studying these children, a significant correlation has been found between mean length of utterance and amount of symbolic play (Lovell, Hoyle, & Siddall, 1968). A more general relationship between play, language, and cognition has been found in studies of this group. Children with delayed language production also tended not to have advanced to symbolic play nor to have developed means-end thinking abilities (Snyder, 1976).

Sherrod, Siewert, and Cavallaro (1984) investigated the relationship between play maturity and language. The researchers compared performances of 11 children, who were diagnosed as language delayed by their teachers but not otherwise cognitively delayed, to younger children matched on language age. The play patterns of these two groups of children were examined to determine whether chronological age or language ability contributed more to mature play. Observations of play were made in 10-minute segments during free play outdoors or indoors. The researchers found that older children with language delays demonstrated less mature play patterns than did children in the younger group.

The results of these studies support a correspondence between play ability and language ability. The exact nature of these relationships must continue to be explored.

Children with hearing impairments

This group of children seems to follow the same pattern of development of play as other children, but the rate of acquisition is slower (Darbyshire, 1977). Moreover, it appears that young children (ages 4-6) with this handicap generally use little or no language in their play, and older children (ages 6-9) generally use only fragmented language that is difficult to understand. The play of children who are deaf is similar to that of children who have hearing and are 2 to 4 years older. Finally, the developmental sequences of play are similar in these two groups, but the former group's movement through those sequences is slower, in tandem with slower language acquisition (Sisco, Kranz, Lind, & Schwarz, 1979).

A study by Best and Roberts (1976) examined the sensorimotor development of 16 children who were hearing impaired, ages 23 to 28 months, using the Uzgis and Hunt (1975) Infant Scales of Psychological Development. They concluded that children with hearing impairments were not significantly delayed in sensorimotor development, compared to children with normal hearing. Although this is encouraging information, other play deficits have been noted as these children begin to acquire symbolic play skills. For example, in a study designed to classify the free-play skills of children with auditory handicaps, Higgenbotham, Baker, and Neill (1980) designed a scale to guide their observations. Using this scale with a sample of preschool children with severe hearing impairments, Higgenbotham and Baker (1981) found that children with hearing impairments spent considerably more time engaged in constructive play than the nonhandicapped group. Their findings also indicated that the normal hearing group spent significantly more time in dramatic play. They stated that this was indicative of a generalized symbolic deficit in children with hearing impairments.

These studies indicate that children with hearing impairments are discontinuous in play development as they move from sensorimotor experiences to symbolic play. Perhaps the best explanation for these findings is provided by Tomlinson-Keasey and Kelly (1974). They suggest that, while the sensorimotor development of these children may not be language dependent, their auditory problems make it difficult for them to transform an object into multiple labels, or labels into objects. Language ability again plays a definite role in the level of play within this group. Mature play is associated with the use of hearing aids before the age of 2 years, early language training or therapy, and high socioeconomic status (Darbyshire, 1977).

The play difficulties of young children with deafness are illustrated in an observational study of the social and communicative interactions of two brothers, a 3-year-old with hearing and a 4-year-old with deafness (Kaplan & McHale, 1980). These children demonstrated few symbolic behaviors (i.e., gestures, signals, and modeling) for

communication during free play. Seventeen percent of the younger hearing child's attempts to communicate were not noticed by the older brother with deafness. The younger brother always gave up after his first unsuccessful attempt to secure his brother's attention. Both brothers experienced failure to communicate, illustrating some of the communication difficulties between children with and without hearing impairments.

Vandell and George (1981) have been particularly interested in the play interactions of children with hearing and children with profound deafness. In their observational study of children with and without hearing, they found that both groups of children interact more with a partner who had the same hearing status than with a partner who had differing hearing abilities. This pattern was demonstrated in both frequency and duration. That is, the children without hearing impairments communicated more frequently and longer with other children with hearing than with children with hearing impairments. The children with hearing impairments interacted more often and longer with children who were also hearing impaired as compared to children with hearing. This study suggests that social play is facilitated when partners have similar communicative skills.

Children with blindness

The play of children with blindness differs qualitatively as well as quantitatively from the play of children with sight. Children with visual impairments show less interest in toys and are often content to be left alone. Their play easily regresses into simple, primitive activities (Deutsch, 1940; Wills, 1969). Warren (1984) reports that children who are blind engage in less active play. It may be, however, that during these periods of inactivity these children are gathering information through auditory and tactile modes to learn the rules of their physical world. The development of object permanence—an understanding that displaced objects are "someplace"—is delayed also in children who are blind. Fraiberg (1977) notes that this understanding is "crucial in the development of the process of differentiation of self and outer world" (p. 40). Barraga (1983) notes that a strong emergence of self may be delayed in these children, compared to children with sight.

Children with blindness need more stimulation than children with sight to become interested and engaged in their environment, but usually receive less stimulation than children with vision. This observation is supported by Fewell (1983), who found that even though a 5-month-old infant may become successful with an intentional reach, blind infants maintain their hands at shoulder height in a neonatal posture. This motoric passivity may be explained in terms of the visually impaired youngsters' inability to benefit from certain reflexes that may function to stimulate exploration of the environment. For example, a number of physiologic opportunities are reflexively present in infants, such as the asymmetrical tonic neck reflex (ATNR). An ATNR can be elicited when the infant's head is turned to one side. This reflex is often self-initiated, as when the infant turns to a sound source. The head in this position triggers extension of the extremities on the face side and flexion of the contralateral extremities on the skull side. This position gives the infant an early opportunity to visually explore a distal region of the body by directing his or her field of vision to the hand. These early visual-motor experiences provide natural situations for the infant to develop eye-hand coordination. Children who are visually impaired, though, may not be able to capitalize on this experience, thus offering a hypothesis that explains why the hands of these children remain in a high guard position longer than those of sighted infants.

Building upon the skills acquired during the development of eye-hand coordination is the emergence of ear-hand coordination. This skill is frequently delayed or absent in

children with visual impairments. Warren (1984) notes "considering the apparently spontaneous tendency of the sighted infant to turn his eyes toward a sound source, the function of the visual information that becomes available to him, and the unavailability of that information for the blind infant, it seems reasonable to expect that blind infants might be at a disadvantage in using auditory spatial information" (p. 19). The amount of risk depends on the degree of visual loss and the amount of appropriate intervention.

Infants with blindness demonstrate fewer positive vocalizations to mothers, fewer social interactions, and more periods of negative affect than infants with sight; as a result, mothers of infants with blindness make fewer positive vocalizations (Rogers & Puchalski, 1984). In addition, parents of these children must often restrict the child's motor impulses to ensure safety (Burlingham, 1965). These physical restrictions may result in the child experiencing depression, boredom, passivity, and lowered achievement motivation (Sandler & Wills, 1965). The immobilization required by the child's handicap may cause these children to apply their motor drives to rhythmical and repetitive movement. Overall, the unresponsiveness of infants and young children with blindness and the unresponsiveness/restrictiveness of their parents interact, in effect supporting each other's behavior pattern (Sandler & Wills, 1965).

The child with blindness often retreats into a fantasy life that is weak in ideational content; children with sight score higher on imaginativeness of play, fantasies, and dreams. For example, Fraiberg and Adelson (1977) noted that children with visual impairments were delayed, and showed qualitative differences in the use of dolls. Further, these children typically failed to develop the personalities and pretend lives for their dolls. Although these children may be delayed in their symbolic play with dolls, children with visual impairments are more likely to create an imaginary companion (Sandler, 1963; Singer & Streiner, 1966), this "aloneness" does not result in a rich fantasy life.

This generally pessimistic picture concerning the play of children with blindness is tempered by the results of three studies on the relationship between the level of play and the level of language development in children with this disabling condition. First, there is evidence of some symbolic acts in children with blindness at a mean age of 25.9 months, with these acts appearing at the same time as the use of the word "no" and two-word combinations (Rogers & Puchalski, 1984). Second, 3- to 5-year-old children who are blind begin to represent themselves in play and to give their dolls personality and an imaginary life. This occurs at about the same time as the emergence of the self-referencing pronouns "I" and "me" (Fraiberg & Adelson, 1977). Finally, there were fewer differences in the play of children who are legally blind and children with sight between the ages of 4 and 9 years than at younger ages, again indicating the salutary relationship between cognitive development and play (Tait, 1972).

In summary, children with visual impairments are likely to have play patterns that are qualitatively different from those of children with sight, particularly in the early years. The loss of sight limits available observations of how others engage objects and interact with one another. The result is more solitary play and repetitions of simple physical and sensory-appealing play schemes. This more solitary form of play appears to be more prevalent in the early years of life. When children with blindness are between 4 and 9 years of age and have well-developed language skills, play behaviors appear to be more similar to those observed in sighted children.

Children with deaf-blindness

The ability to assimilate and accommodate early presymbolic play experiences and acquire symbolic or representational play behaviors is often one of the greatest

challenges for children with deaf-blindness. Very little research on the development of play in this group of children has been reported. In one of the few studies conducted in this area, Walker and Kershman (1981) found that inactivity accounted for almost 50% of the behavior of infants with deaf-blindness during a 3-minute play session with their mothers, whereas inactivity characterized only 11% of the behaviors of a matched control group of infants without handicaps. Inactivity together with negative vocalization (crying) accounted for 62% of the time of infants with deaf-blindness, leaving only 38% of time to be interpreted as communicative behavior. The average number of consecutive interactive behaviors with positive affect displayed by the infants also differed, with the rate for children without handicaps being three times as high as the rate for children with deaf-blindness.

Although there is a dearth of studies on the play development of children with deaf-blindness, we suspect that play development will be quite delayed. This is based on what others have reported about the differences in play between children with other types of handicaps and normally developing children. The cognitive deficit so prevalent in young children with deaf-blindness, as reported in the literature, appears to be a major reason for play differences. Cognitive development in these infants and children is likely to be delayed for three reasons. First, children with deaf-blindness have fewer opportunities to establish sensorimotor references for later thought and communication. Understanding of their own and other people's body parts and movement is limited to what they can feel. Their exploration of their environment is limited to the area around them that is within arm's reach, and it is especially difficult to discover cause-effect relationships without the use of sight or hearing. Second, these infants have difficulty experimenting with their actions. They are less likely to generalize schema without being able to observe that different objects in the environment share certain similarities. Experimentation with means-ends relationships must be achieved through tactile experience. Finally, these children are less likely to establish symbolic thought. Without the sensory receptors for tracking objects, it is difficult to acquire object permanence or to mentally represent objects in space and over time. The development of symbolic thought in the absence of visual memory requires the child to store both successful and potential solutions, and to rehearse or re-solve those problems.

Thus, our understanding of the play behaviors of young children with handicapping conditions is constantly expanding. A number of current research efforts are being directed at capturing those discrete play behaviors that correlate with cognitive and communication measures. Currently, we are guided by professional intuition regarding a positive relationship among those skills; however, if that relationship can be quantified our clinical observations of existing play behaviors can serve as the medium for appraising, other critical skills. The intrinsic motivation to interact/operate with test materials in a play setting may elicit those hidden or difficult-to-test abilities in these children. For example, a recent study of an experimental Play Assessment Scale used with children with deaf-blindness (Fewell & Rich, 1987) reported correlations between play scores and receptive and expressive communication measures. Those correlations ranged from .80 to .94, but the correlation between the mean play score and the Callier-Azusa Speech Subscale was only .28. The investigators reported similar findings when play scores were compared to scores on cognitive measure (.85 - .89) and to social measures (.77 - .92). The findings of this study suggest considerable overlap may exist between the play of children who are deaf-blind and their scores on measures of play, language, cognition and social behavior. In sum, assessment of children's play behavior holds promise for gathering developmental information, data that may be unavailable through other more traditional testing means.

Summary

This review of the literature summarizes available findings on the play behaviors of young children who are deaf-blind. However, several gaps in our understanding of these children persist. These include the following:

- * Very little is known about the play of children with deaf-blindness, particularly concerning their presymbolic abilities.
- * Little is known about the relationship between play, cognition, and communication at relatively low levels of functioning. For example, most of the previous research has focused on the relatively close relationship between symbolic play and language development; we know however, that symbolic play is only part of play, and language is only part of communication, and these are both often absent in children who are deaf-blind.
- * Little is known about the causal relationship between play and the domains of cognition and communication in children with handicapping conditions.

Further research is needed on play as a multifunction modality for children with deaf-blindness. Of particular value would be data that demonstrate the utility of play as an assessment tool. Designing a reliable and valid assessment instrument for this population is the initial challenge facing professionals charged with planning appropriate and functional services for these children. Obviously, this may provide us with metrics regarding a child's current developmental status. More important, such an instrument can be used to guide intervention efforts. Knowing the most efficient and effective route toward skill acquisition and growth is of primary concern. The hunch that these children may have an undisclosed intent to communicate, control a discrete element in their environment, or satisfy a basic need may have occurred to many. The means to identify and encourage abilities for these children is an urgent priority for work in this field.

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VIII. Development of Emergent Language

by

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The dual sensory impairments of a child characterized as deaf-blind often leave that child with extreme communication and language deficits. A large number of these children also have concomitant handicaps of mental retardation, medical problems, or physical impairments (Jensema, 1979). These additional handicaps, in conjunction with the auditory and visual impairments, can drastically reduce the child's interactions with his or her physical and social environment. Subsequently, the reduction of environmental interactions can affect the child's language development. The development of language appears to have a cognitive and social basis (Bates, 1976; Bricker & Carlson, 1981; Bruner, 1975a, 1975b; McLean & Snyder-McLean, 1978) in which language develops only after a relatively sophisticated nonverbal communication system has been established through caregiver and child interactions (Mahoney, 1975). Children with auditory and visual impairments must use somewhat different strategies to learn language. Since there are relatively few data concerning the communication and language development of children who have both visual and auditory impairments, developmental data with other disabled and nondisabled populations do provide other sources of information in developing communication intervention programs.

Four major components are necessary for any language system: the modality or the type of communication system (oral, manual, tactual-manual, other abstract symbols), the form (or rules) of the language system, the content of the language, and the communicative use or functions. Much of the literature specific to language development for persons with hearing and vision impairments is concentrated in the area of the different modalities or communication systems that are available (Curtis, Donlon, & Wagner, 1970; Dinsmore, 1959; Jensema, 1979; Kates & Schein, 1980, 1983). Although these documents provide descriptions of the oral, visual, or tactual modalities, the majority do not discuss the semantic (content) or pragmatic (use) components of language. Recent research with young children without disabilities (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979a; Dore, 1975; Sugarman, 1977) and with children with language delays (Greenwald & Leonard, 1979; Kahn, 1984; Mundy, Seibert, & Hogan, 1984; Snyder, 1978) demonstrates that intentional communication develops prior to the onset of a symbolic language system. Consequently, children learn to communicate before they learn a language system. Van Dijk's (1967) approach to communication programming with deaf-blind children does focus on a level of prelanguage communication in which both social and cognitive aspects are incorporated into his movement techniques.

One of the problems in conducting longitudinal research with children who are vision and hearing impaired is their extreme variability. A total absence of auditory and visual abilities occurs rarely with children with deaf-blindness (Kates & Schein, 1980). Therefore, the degree and onset of hearing and vision losses are extremely variable. Additional factors such as cognitive impairments, motor impairments, adaptive aids, and parental interaction patterns increase the variability of children with hearing and vision impairments. Often vision and/or hearing impairments are not identified until after the child is 2 years of age (Fredericks & Baldwin, 1987). The criterion of eligibility for a child to be identified as deaf-blind often varies across states (NASDSE, 1982). The variability of the child's sensory losses and the age of their identification contribute to the difficulty in collecting research data specific to the early communication and language development of these children. It is important that general-

izations are not made based on individual case studies of older children having hearing and vision impairments (Rees, Kruger, Bernstein, Kramer & Bezas, 1974; Yarnall, 1980). Children exhibiting more severe hearing impairments, rather than vision impairments, may acquire language somewhat differently than a child who is blind and has a moderate hearing loss. Therefore, the similarities and differences within a population of children and across different populations may provide new insights in collecting observational data and in designing communication interventions for individual children.

The following review will summarize (a) earlier and recent models of child language development, (b) emergent language development in children with handicaps, and (c) emergent language development in children with sensory impairments. Within each of these sections, the importance of communication intents and early communicative behaviors will be stressed. In addition, the relationship of nonlinguistic and linguistic modes within the transition to referential communication will be discussed. The major topic addressed throughout this review is the process by which a child, characterized as deaf-blind, learns to use conventional symbols to communicate and the type of skills that precede the emergence of referential communication development. Subsequently, four major questions need to be addressed in order to use this research in communication intervention programs. These questions include (a) How do young children without disabilities acquire a symbolic communication system? (b) What are the individual differences in language development? (c) Do children with disabilities acquire language in a similar sequence? and (d) What adaptations or strategies must be used by caregivers of children with sensory impairments? These questions relate primarily to what to target in intervention programs. Since the majority of deaf-blind children will not acquire language without special intervention, the procedures in language training for persons with severe handicaps also need to be addressed.

The Development of Emergent Language in Children Without Disabilities

Although the developmental-versus-difference controversy related to the cognitive development of children with mental retardation is still at issue (Weisz & Yeates, 1981, p. 153), the majority of studies indicate that persons with nonorganic, mental retardation go through the same cognitive developmental stages as do persons without retardation (Taylor & Achenbach, 1975; Zigler, 1969). A number of researchers concerned with the acquisition of language have taken a developmental stance. That is, individuals with mental retardation seem to acquire language skills in the same general sequence as do children without disabilities (Leonard, 1972; Miller & Yoder, 1974) but at a slower rate and to a lower capacity (Kahn, 1975; Ryan, 1975). Other researchers (Menyuk, 1964; Cromer, 1979, 1981) have indicated that children with language disorders may use or learn language somewhat differently than their peers. Zigler (1967) has stated that persons with organic impairments differ in cognitive development from those persons without organic impairments. Children with organic or sensory impairments may also demonstrate somewhat different acquisition patterns in developing communication and language. Recently, a number of studies of language acquisition have focused on the importance of individual differences in the language acquisition process (Bloom, 1973; Nelson, 1973, 1974, 1981). Therefore, even though children with handicaps may acquire language in a sequence similar to that of children without delays, there may be different processes that even "normal" (sic) children use as they develop language. However, it is important to know the features of communication development before modifications can be made and their effectiveness assessed.

Ervin-Tripp (1973) describes three general prerequisites for the development of language: (a) input from the environment, (b) knowledge and understanding of events around the child, and (c) perceptual/processing skills. The impairment of the "far" senses

of the child with hearing and vision handicaps does, in fact, affect the way in which these children perceive their environment and possibly the way in which they process their experience and knowledge of the environment. Uzgiris (1981) points out that a functional or organic impairment may reduce the opportunities for certain kinds of experience or interactions within the environment. She suggests that alternative routes and intervention strategies may be necessary. In order to understand the alternative models that children with hearing and visual impairments may need to follow to acquire a communication and language system, it is necessary to understand the basic components of language and to describe the cognitive, social, and linguistic processes that children without disabilities experience. Additionally, research on the similarities and differences in the language acquisition of populations that are handicapped, yet nonsensory impaired, can provide data that can be used to formulate research questions that are specific to children with sensory impairments. It is essential that we do not generalize findings across different populations without additional data or careful consideration. Nevertheless, much current research can guide our efforts to analyze how children with sensory impairments may be able to acquire a language system or what adaptations may need to be made.

The Relationship of Social-Cognitive Development and Language Development

Bates (1979a) contends that "the foundations of early language development are characterized by the onset of communication intentions and conventional signals, and the emergence of symbols and the discovery that things have names" (p. 33). The specific development of nonlinguistic signals, their use in social interactions, and the relationship of these early nonlinguistic signals to referential speech can provide a framework for developing communication and language interventions for children with severe handicaps in that a basis of communication development must be considered prior to developing referential speech or symbolic augmentative language systems.

The development of nonlinguistic communication signals. Bates, Camaioni, and Volterra (1975) have proposed a hierarchical sequence of communication development that takes into account behaviors, or speech acts, before words are produced. The three levels proposed by those authors are perlocutionary acts, illocutionary acts, and locutionary acts. Perlocutions are defined as early behaviors that are produced by the infant and have an effect on the adult. Even though these behaviors are not used intentionally to communicate, the onlooker systematically interprets these early behaviors as purposeful. Brazelton, Koslowski, and Main (1974) stress that it is important for the caregiver to assign meaning to the child's early signals and that parents truly believe that the child's behaviors are intentional. Illocutions are conventional, nonverbal signals that are produced intentionally by the infant to have a specific effect on the listener. These prelinguistic behaviors or acts are used to express a specific social function. Sugarman (1977) asserts that the major function of these behaviors are (a) to use a person to obtain an object, and (b) to use an object to get a person's attention. These early nonverbal communication behaviors presumably grow out of joint action and joint attention routines between the infant and primary caregiver (Bruner, 1975b). Finally, locutions are conventional symbols (words, signals) that can be used in isolation or in combination to serve a specific communication function (requesting or answering).

In order to use intentional prelinguistic behaviors in communication programs for children with handicaps, it is necessary to define an early behavior as an intentional signal. Bates (1979a, p. 35) lists three changes of the child's behavior as evidence of communication intentionality. These involve (a) alternate eye contact between the goal and the adult or checks by the child for feedback from the adult, (b) the augmentation, addition, or substitution of signals contingent upon adult behavior, and (c) the form of the

individual signals. It may be necessary to redefine Bates' criteria before using those criteria of intentionality with children having visual impairments since eye contact may not be possible. It is essential that orientation or some form of recognition of the adult as an agent, or as a means to a goal, be demonstrated by the child. Even though a number of persons define communication differently (see Thoman, 1981), Schaffer (1977) proposes that the constituent skills for communication are intentionality and role alteration. Bates, Benigni, Bretherton, Camaioni, and Voltera (1979b) and Sugarman (1977) have pinpointed the beginnings of intentional communication with children who are not disabled at between 9 and 13 months of age. Specific nonlinguistic (or preverbal) communication acts include showing off, giving objects, showing objects, communicative pointing, ritualized requests, and other conventional gestures (extending hand, gestures "all-gone, mine, no-yes"). The child's signals change and are used more regularly prior to the use of referential speech.

There is a growing body of empirical research on gestural development (Dobrich and Scarborough, 1984; Masur, 1982, 1983; Messer, 1983; Murphy, 1978; Scaife & Bruner, 1975). Much of the research that is available has concentrated on the pointing gesture and its relationship to language (Lempers, 1979). Gestural development is seen as deriving from the early infant/caregiver social interactions (Lock, 1978) and from cognitive development. Steckol and Leonard (1981) found that the opportunity to observe demonstrations in the use of objects facilitates use of communicative gestures. This suggests that direct manipulation of objects and/or the observation of object use in social interactions play critical roles in gestural development. There is evidence (Bruner, 1983; Veneziano, 1981) for the synchronous emergence of both motor (gesture) and nonlinguistic vocal behaviors. The form and function of the pointing gesture and speech were examined in a study by Dobrich and Scarborough (1984) with 2-year-olds. They found an absence of relationships between the precision and complexity of the pointing gesture (form) and what communication purpose (function) was being served. Findings also indicated a lack of association between the gestural-verbal form and vocal-verbal form (articulation skill).

Most research that is available on gestural development has been conducted immediately prior to or during the emergence of speech. Communicative pointing seems to be one of the later gestures to develop and, according to Bates, Benigni, Bretherton, Camaioni, and Voltera (1977), seems to be one of the best predictors of symbolic language since, in pointing, the child begins to communicate about an object without having direct contact with that object (Dubose, 1978). A study conducted by Pechmann and Deutsch (1982) indicates that if children are not able to use a specific language utterance for reference, they are likely to use nonlinguistic means that may be inappropriate for the particular context. These results suggest that pointing and concurrent verbal references are somehow related to one another. As Schaffer, Hepburn, and Collis (1983, p. 338) state: "The precise relationship between verbal and nonverbal aspects of communicative acts directed to language-learning children remains to be established." Previous studies do indicate that the conflicting findings may be based on a number of variables. These include the definition of the types of gestures being examined, the form and functions being examined, the specific aspects of the environmental context, the precise nature of the linguistic utterance being examined, and the age at which the children are observed. Dobrich and Scarborough (1984) stress the need for additional research on the form and function of different types of communicative gestures in order to investigate the gestural complex more adequately.

The role of linguistic and nonlinguistic features in mother-child interactions.

Mahoney (1975) proposes that, for language to develop effectively, children must be able to detect meaning by some nonverbal means. Additionally, parents must also be able

to determine from the child's nonlinguistic cues that their attempts to communicate are not too complex for the child. A large body of data exists concerning the characteristics of maternal language and the role adult speech plays in the child's development of language (Snow, 1979; Snow & Ferguson, 1977). A number of studies (Cross, 1978; Mueller, 1972; Phillips 1970) indicate that caregivers focus their speech on what the child is visually attending to or interacting with. However, there is a lack of extensive research specific to the role of mother's nonlinguistic gestures in receptive and expressive language development and the mother's corresponding responses to the child's gestures (Schaffer et al., 1983). Data that do exist (Bridges, 1979; Gutmann & Turnure, 1979; Rodgon & Kauffman, 1979) represent conflicting findings regarding the frequency and complexity of maternal gestures to children at different ages.

A number of authors have examined the use of literal cues used by mothers in relation to conventional gestures and verbal directives. Mothers of younger children seem to pair literal cues (tapping the child) with attention-getting pointing gestures more frequently than do mothers of older children (Murphy & Messer, 1977). Schaffer and Crook (1979) report similar findings. Although mothers of 15- to 24-month-old children used literal cues of manipulating an object to seek the child's attention, the tendency to use literal cues was more prevalent with the mothers of the younger children.

Findings reported by Adamson and Bakeman (1984) show that mothers gradually altered their literal markers and self-referential communication to use more object reference and conventional means during infant-mother interactions within the period from 6 to 18 months. These findings are consistent with those by Snow (1977) and Sherrod, Crawley, Petersen, and Bennett (1978). Their findings indicate that mothers use more affect-laden speech with their 4- and 5-month-old infants, with more comments directed at the infant's internal states in purely social interactions (i.e., "You're hungry."). Within the next 4 months, mothers change their speech style to their 8-month-olds by using more meaningful speech, consisting of requests for direct attention in specific interactions (i.e., "Tony, look here."). One could speculate that the child's increase in motor development and intentional behavior is, in part, responsible for the shift in the mother's communication style. Indications of the child's increasing comprehension and preverbal behaviors would seem to have a dramatic effect on maternal nonlinguistic and linguistic communication prior to the child's entry into a referential language system.

The use of nonverbal cues paired with verbal directives seems to increase the child's compliance with attention-getting directives (Schaffer & Crook, 1980). Conversely, compliance with action-getting directives does not seem to be significantly increased by nonverbal cues. Recently, Schaffer et al. (1983) examined different types of maternal nonverbal cues (manipulate object, model, point) in relation to both attention and action directives with 10- to 18-month-old children. A clear, positive relationship between the mother's verbal and nonverbal behavior existed only with the older group of children. More interesting is the relationship of the type of nonverbal cue and the type of directive. The mother's manipulation of objects was closely associated with attention directives; whereas, modeling and pointing were associated with action directives. However, pointing appeared to supplement the verbal directive rather than add redundant information. Individual differences among the mothers of the younger children indicated that, the more a mother used nonverbal and verbal directives in a paired manner, the higher the child's compliance score. These findings and those of Shatz (1982) suggest that mothers often combine simultaneous verbal and nonverbal directives, but that the information provided by the dual modes often has different meanings. A study conducted by Allen and Shatz (1983) suggests that maternal gesturing may play a role in getting the child's attention and to perform action behavior, but does

not seem to play a direct role in the comprehension of early questions. These results indicate that information provided through the gestural mode may be processed independently of speech.

The body of research on the ways in which mothers respond to their children's preverbal communication attempts is also important (Edwards & Goodwin, 1985; Moerk, 1975). First, the child's early gestures provide the mother with some indication of what the child understands. Second, the mother's differential responses to the child's gestures also provide a type of "scaffolding" technique (Bruner, 1983) that serves to lead the child into a more complex communication system. Research on mothers' responses to their children's prelinguistic communication (Masur, 1982) demonstrates that mothers are more apt to respond consistently to the child when the child extends objects, but they respond differentially to the child's pointing, by providing a label. The strong demand quality of gestures toward the listener, plus the contextual nearness of the object, may account for the earlier presence of giving and showing objects and the later development of pointing. Masur's (1982) work and research by Corsaro (1981), and Messer (1978) highlight the possible impact of mothers' responses to early gestures upon the transition into language or referential communication. Ninio and Bruner (1978) report that mothers respond to their infant's pointing by labeling pictures in book-reading routines. The results of a study conducted by Messer (1978) indicate that the manipulation of a toy during joint attention routines was synchronized with maternal reference to that toy, thus providing the infants with information about that object. Pointing to distant objects (Murphy & Messer, 1977) is another strategy that integrates the mother's and the infant's attention to important features of the environment. The sensitivity and synchrony that mothers use to respond to their infants' nonverbal behaviors during joint activities indicate that the social interaction between the mother and child seems to contribute to the child's movement into a symbolic communication system (Ninio, 1985). The effect of the mother's speech on the prelinguistic and linguistic development of infants and the circular effect of the infants' nonverbal interactions on maternal input have important implications for both the assessment activities and intervention programs for infants with sensory impairments.

The relationship of conventional prelanguage communication to symbolic communication. Although few persons would disagree that, to communicate, a child uses nonlinguistic means prior to linguistic means, conflicting theories exist regarding the precise developmental relationship between nonlinguistic (gestures) communication and language (see Dobrich & Scarborough, 1984 for a review).

Longitudinal studies conducted by Bates and her colleagues from 1972 (Bates et al., 1979a, 1979b) provide support for a homology model of language in which cognition and communication developments are related only indirectly to language. Intentional communication expressed through conventional signals is viewed by Bates (1976) and Bates et al. (1979a) as a process that precedes, correlates with, and eventually contributes to the emergence of symbolic communication. These authors found that a subset of prelinguistic communicative measures predicts the emergence of symbols in both language and play. Their longitudinal research data with 25 children indicate that the emergence of symbols is correlated with imitation, tool use, and manipulative play, as well as to the frequency and sophistication of preverbal communication. The young child's gestural communication system expands, and conventional signals are used more regularly during a 4- to 5-month period before the child transitions into symbolic communication (Bates, 1976; Bates et al., 1975; Bates, Camaioni, & Volterra, 1976; Bates et al. 1979a, 1979b).

More recent research indicates that the relationships between language and gesture may include only the functional aspects of both (Dobrich & Scarborough, 1984),

with language developing independently from gestural development. Even though children may learn to understand gestures and nonlinguistic devices prior to language and use gestures and language in parallel fashion (Schaffer et al., 1983), there is little evidence that the child's linguistic system is based solely on understanding maternal gestures (Shatz, 1982). Findings by Allen and Shatz (1983) suggest that gestural information may be processed relatively independently of speech.

The development of communication functions in prelinguistic/linguistic development. The shift in the emphasis from a syntactic-semantic model of language acquisition toward a pragmatic model highlights the fact that language is more than words and structure. From a functional viewpoint, there is language as soon as there are meaningful expressions (Halliday, 1975). In intensive studies of the linguistic development of a few children, Dore (1974) and Halliday (1975) found that the transition into a more formal language system is made through the initial use of protowords (e.g., "da" = want), early speech acts (e.g., gi = give), and one-word utterances (e.g., "dog") that are used to express different communication functions.

In addition to the work of Bates et al. (1979a, 1979b), recent research by Carpenter, Mastergeorge, and Coggins (1983) has investigated the acquisition of nonverbal intentional communicative behaviors of infants between 8 and 15 months of age. They found a significant trend for early communicative intentions to emerge in the following sequence: protesting, request for action, request for object, comment on action, comment on object, and answering.

The specific communicative intentions expressed in early prelinguistic and linguistic development have been categorized differently by a number of persons (Carter, 1975; Dore, 1974; Halliday, 1975; and Moerk, 1977). The majority of taxonomies of communication functions are based on the child's utterances, nonlinguistic aspects surrounding the utterance, and the environmental context. Dore's definitions (1974) of pragmatic functions (request action, protest, calling, request attention, etc.) are also based on the adult's response to the child so that the functions are defined on the entire communication interaction. Halliday (1975) found that four functions, such as regulatory (do what I say), instrumental (get what I want), personal (see me, see what I see), and interactional (you and me) are used before the heuristic, imaginative, and informative functions. These later functions are observed to occur prior to dialogue in which the child responds specifically to a question (when the information is not known by the listener), or responds to a statement, or responds to a response. Halliday's (1975) analyses of protowords, one-word utterances, and multiword utterances show that specific words are first used to express a single function, whereas, different words express other functions. Later, words are used to express multiple functions. The development of two-word utterances seems to follow a similar pattern.

Only recently have the more pragmatic aspects of maternal speech to prelinguistic children been examined (Cross & Morris, 1980; Masur, 1983; Penman, Cross, Milgrom-Friedman, & Meares, 1983; Sherrod et al. 1978). Trevarthen and Hubley (1978) have suggested that a child first develops a communicative mode of behavior in which the child interacts only in social-person interactions. These authors' findings indicate that the mother's early forms of "contentless" speech co-occur with the child's communication mode. Later, as the child begins to focus and interact with the physical world (praxic mode), mothers change the general function of their speech to include references to objects and events. Penman et al. (1983) also found that there is a trend for mothers to use more informative types of speech utterances as the infant develops, regardless of infant mode. They also found that mothers increase their use of questions and reports as the child matures. Folger and Chapman (1978) have investigated the distribu-

tion of the speech acts of six mothers of 21-month-old children. They found that requests for information are the most frequent, followed by statements and then requests for actions. Chapman (1981) reported that requests for action or attention are given frequently when the child is already attending or acting on an object. Additional data by Rondal (1978) demonstrates that actual requests for action by the mother decrease across the second year of development despite the child's growing ability to perform actions (Chapman, 1981b). The overall low proportion of requests for actions or directives from mothers of children without handicaps may provide some guidelines for more "normalized" interaction patterns on a functional basis. Data collected by Bates (1976) and Shatz (1978) indicate that children as young as 24 months respond equally well to indirect requests (Would you come here please?) as to direct requests (Come here). Children often understand the "intents" or speech acts of mothers' utterances before understanding the utterance literally (Rees, 1978). Many of the studies concerned with the pragmatic function of the mother's speech have not reported on the concurrent nonlinguistic features that mothers may use. There seem to be some basic differences in the pragmatic functions of mother's speech as the child transitions into a language system (Folger & Chapman, 1978). A few of these differences include the concurrent use of gesture and language utterances for different functions. Whereas children often use gestures and language to indicate a descriptive (or comment) function; mothers tend to use a pointing gesture paired with a verbal request (Dobrich & Scarborough, 1984; Masur, 1981; Murphy, 1978) in order to provide additional information.

The Emergence of Symbols

The sequence of behaviors preceding symbol use has implications for the emergence of less concrete symbols, as well as for the more abstract symbols. The emergence of the first words (or first signs) is not necessarily the beginning of symbolic communication. As discussed earlier, the emergence of symbols seems to be preceded by the corresponding development of tool use, imitation, and preverbal communication. In summarizing their data, Bates et al. (1979a) have proposed a critical threshold model between imitation, tool use, and communicative intent in which all three behaviors must reach some level of complexity before symbolization occurs. Unfortunately, it is not known what these specific threshold levels are. The data suggest that the transition into symbolic communication is a gradual process (Nelson, Engel, & Kyratzis, 1985) in which protowords or wordlike sounds serve specific pragmatic functions (Dore, 1975; Halliday, 1975; Stoel-Gammon, & Cooper, 1984). Subsequently, vocalizations approximating adult-like words are used within functional, routine activities. At this point, the word may be tied more to the routine itself than to a specific referent (Bates et al., 1979a). Next, referential words are used within a range of contexts. Only at a later point is the word or symbol distanced from the referent, in that the referent does not have to be immediately available (Bates et al., 1977; Bates et al., 1979a). This concept of distancing the signal from the person-object referent is defined as "decontextualization" by Werner and Kaplan (1963) and is discussed in detail by Bates et al. (1979a). Volterra, Bates, Benigni, Bretherton, and Camaioni (1979) observed that words (symbols) and symbolic gestures with objects (in play) follow a similar pattern of acquisition, in that the distancing from the referent or from the object (in symbolic play) occurs in both language and play. Therefore, development within nonsocial activities seems to be associated with developmental parallels in referential communication. However, children do not seem to demonstrate gestures without acting on the object in some way (Bretherton et al., 1981).

Prelinguistic communication does not seem to decrease as children acquire their first words. Rather, more prelinguistic gestures are added to the child's repertoire. At the same time, children also increase their use of symbolic gestures (as a toy phone to

their ear) while using first words (Volterra et al., 1979). Data from a longitudinal study by Volterra and her colleagues indicate that children (9-13 months of age) may use similar vocabularies, either in gestural naming or in verbal naming. By testing, maternal interview, and observation, it was demonstrated that children use gestural names and verbal names during the same period. Thus, language does not replace gestures (Gutmann & Turnure, 1979); rather, gestures continue to increase in their complexity and form as language is learned (Wilksen & Rembold, 1981). Either a gestural symbol or a vocal symbol is used to identify or request a referential object, event, or activity. As children begin to use gestures and words concurrently, the gestures seem to be used as attentional devices and to add more information (Dobrich & Scarborough, 1984). The continuity of language development remains as more referential words (mama) are acquired by children. As children's vocabularies develop, more nonreferential words (e.g., that) continue to be added as referential words (e.g., cracker) increase.

The overlap and continuity between gestural communication to use of nonreferential words and to use of referential words, demonstrated by children who are not disabled, provide insights into the establishment of criteria in intervention programs. Even though most children use words (and play) as their first symbolic behavior, the first representations used by children with severe vision and hearing impairments may not be abstract words or signs. Rather, more concrete objects, gestures, and object representations may need to be trained before the child with deaf-blindness is able to understand and use more abstract symbols. Moreover, if young children without handicaps express varying levels of communication and language within the acquisition process, we should not expect children with sensory handicaps to make a sudden and total shift into another form of communication or language. For example, even though a child may use a few signs, additional prelanguage gestures may be targeted within the intervention as well.

Early comprehension and imitation. The roles of both comprehension and imitation in the language acquisition process have been debated by numerous researchers (e.g., Bloom, Hood, & Lightbrown, 1974; Brown & Bellugi, 1964; Clark, 1977; Dale, 1976). Uzgiris (1981) proposes a different role of imitation within language acquisition, suggesting that imitation and joint executions of action may have communication functions, in that they may create a sense of mutuality between the infant and partner. Kagan (1976) and Bates et al. (1979a) propose that, in the early stages of language development, children do not imitate something that is not familiar to them. In general, comprehension of words seems to precede production (Nelson, 1973). Additionally, children often imitate words that they comprehend or that they are in the process of acquiring. Children between 9 and 13 months do not seem to imitate words that they do not comprehend or that they are not beginning to produce spontaneously (Volterra et al., 1979). These findings indicate that children may also need to understand gestures prior to imitating them.

The database on the relationship of imitation to language has been extended in a recent study by Leonard, Chapman, Rowan, and Weiss (1983). Their findings suggest that imitation does not facilitate comprehension; that imitation may initially facilitate children's ability to acquire words, but may decline after a time when words are used imitatively and spontaneously; and that imitation of novel words may be done by children when they are not able to contribute new information to the topic. There seems to be a tendency of some individuals with severe handicaps to imitate the last word addressed to them once they have acquired a limited vocabulary. One could speculate that the person does not understand the intent of the utterance/sign (request, question, comment) and yet attempts to maintain the interaction, or that the person imitates because of inability to add new information within the exchange.

It is necessary for studies of language comprehension to include pragmatic variables (Rees, 1978) since mother-child interactions typically occur in rather restricted contexts. Schaffer et al. (1983) also suggest that mothers adapt tasks in order to increase compliance. Thus, children may seem to understand more due to social variables (person, place, context) rather than lexicon and syntax. Miller, Chapman, Branston, & Reichle (1980) assessed the comprehension skills of 1- to 2-year-old children. Their data show that children comprehend words referring to objects and people sooner than action words. Additionally, comprehension of words that refer to objects that are visible occurs prior to comprehension of objects outside the "here and now." At about 16 months of age children begin to comprehend action-object utterances.

The acquisition of a lexicon. The types of words that children acquire before using multiple-word utterances (Nelson, 1973; Stoel-Gammon & Cooper, 1984) and those recommended for language training (Holland, 1975; Lahey & Bloom, 1977; Karlan & Lloyd, 1983) are based on a similar criterion. Overall, children first learn words that have communicative value and occur in the "here and now" (Lahey & Bloom, 1977). Mervis (1983) contends that, for a child to comprehend words and acquire a lexicon (vocabulary), there must be a transparent relationship between the word and referent. She points out that mothers need to use deictic utterances ("That's a kitty.") while the child is attending to the object in order for the transparency to be established. The representations that the child can build about objects and actions plays an important role in the development of early protowords (Gillis, 1984). Moreover, the majority of first words accompany the child's actions on objects (Greenfield & Smith, 1976). Another primary attribute of the first words that children learn is that their referents change or move in some way (Mervis, 1983; Nelson, 1977). These include words for (or are specific to) food routines, people, animals, and toys. First words also include those that accompany action schemes with persons and objects and that are names for persons or objects acted on in familiar games and routines. In summary, children use words in the following sequence: (a) as a procedure or to stand for a routine, (b) to announce anticipation of a routine or interaction, (c) to designate actions carried out by himself or others, and (d) to categorize persons, objects, or events with decreased contextual support (Volterra et al., 1979, p. 175-176). Initially, the child's first words (symbols) are tied directly to the visual content and are gradually used to express context that is not immediately visible, or connected directly to, familiar routines (decontextualization). Children also learn to communicate about things that are not tied to themselves.

Individual Differences in Language Development

Recently, attention has been directed to the differences that individual children bring to the task of acquiring and expanding initial language. In a longitudinal study with presyntactic children, Nelson (1973) found that children show individual approaches to language learning. Her major finding is that some children's early vocabularies consist of a large number of clearly articulated nouns. These children are termed "referential" communicators. Other children use more phrases within social routines. This type of child imitates more readily (Bloom et al., 1974) and uses a large number of pronouns, whole phrases, and poor articulation (Nelson, 1981) as well as different intonation patterns (Dore, 1974). These children are labeled "expressive" learners. Other findings by Nelson (1973) indicate that children acquire language more rapidly when the styles of the mother and child match. For example, children who label objects and events in a manner similar to their mothers, rather than using more social phrases, reach later language milestones more rapidly. From the results of the preceding investigations, it can be concluded that rates of early productive language acquisition do not seem to be as predictive of later language development as are levels of comprehen-

sion and mother-child interactions (Nelson, 1973, 1981). Additional evidence (Peters, 1977) suggests that the environmental context may play an important role. Children may demonstrate different styles across different environmental contexts.

Summary

Recent theoretical perspectives and research in language development can provide general information for communication interventions for populations with handicaps. The major findings discussed in the previous section are summarized below.

- . Early language development has both a cognitive and social basis.
- . Children express some forms of communication intent prior to the development of a language system, with the order of emergence as follows: protesting, requesting action, requesting object, commenting on action, commenting on objects, and answering.
- . Imitation, tool use, play skills, and prelinguistic behaviors are interrelated with the emergence of symbols within a possible homology model.
- . Mother-child communicative interactions are central to the child's language development, with mothers providing directives or labels for objects/events that the child is already focusing on.
- . Children express some early gestural communication before using words. The sequences of development include showing off, giving/showing, and communicative pointing, with communicative pointing being the best predictor of language development. The specific relationship of gestures to language is yet to be determined.
- . Children seem to develop different styles of communicating during the early phases of language development or use different styles depending on the social context.
- . Children seem to imitate words that they comprehend or are beginning to use; yet, imitation does not seem to facilitate comprehension.
- . Children first use words that "stand for" a routine interaction. Words then go through a gradual process of "decontextualization" in which children are able to use words for objects that are not visible and for actions and events outside of themselves, and "denaturalization" with a decreasing material similarity between the symbol and the referent.

The research reviewed in this section indicates that the child's prelanguage behaviors should not be assessed in isolation. Instead, these behaviors are measured best during mother-child interactions. Whereas the broad categories of prelanguage behaviors or gestural communication do provide a sequence for training (e.g., extending objects prior to pointing), severe visual impairments may limit the child's capacity to engage in communicative pointing. Additionally, hearing limitations reduce the early vocalizations and protowords that serve early communication functions. Alternate strategies of distancing the referent from the child's immediate contact may be necessary before the child with sensory handicaps is ready for a symbolic system. A number of the preceding results may be more applicable than others to intervention programs. Furthermore, a number of adaptations may need to be made before these findings can be integrated into interventions for children with auditory and visual impairments.

The Development of Emergent Language in Children with Handicaps

The extensive body of research data collected by Bates and her colleagues (1975, 1976, 1979a, 1979b), specific to the relationship of cognitive, social, and linguistic skills, has prompted a number of studies to determine if children with handicaps develop language in a similar sequence and manner as children without disabilities. Earlier work that focused on the uses or functions of language (Bruner, 1975a, 1975b; Dore, 1975; Halliday, 1975) changed the focus of many communication programs for children with delayed language or other handicaps. Snyder's (1975) study was one of the first to systematically investigate the relationship of cognitive and linguistic development with language-delayed children. Before then, many persons had speculated that object permanence was an essential precursor to language development. The results from Snyder's study demonstrate that means-end (tool-use) skills are significantly correlated to the emergence of language with children who are language delayed. She also found that children in her study used gestures more than linguistic forms even though the children could produce the linguistic forms.

In general, most research in language development with children who are delayed has been conducted with children who have language delays or who have Down syndrome. The four major lines of research to be addressed within this section include (a) the relationship of cognitive skills and language development, (b) the development of communication functions, (c) the sequence and use of prelinguistic and linguistic communication, and (d) mother-child interactions. The major question addresses whether or not children who are delayed or handicapped learn language in a sequence similar to children without apparent handicaps.

The Relationship of Cognitive Skills and Language Development

In a replication of Snyder's study, Rowan and Leonard (1981) found somewhat contradictory results. Children with language delays and the children without disabilities seem to express imperatives (requests/commands) and declaratives (label/commands) primarily by words rather than gestures. Results of an earlier study with a different population (Greenwald & Leonard, 1979) indicated that children with Down syndrome and a group without disabilities developed gestural and linguistic communication similarly. However, the older children with handicaps used words at sensorimotor Stage V even though the younger children were not using words. These results confirm those by Ingram (1981) that indicate some children may use words prior to achieving Stage VI.

The association of sensorimotor skills to early communication and language development in 54 children with developmental delays has been investigated by Mundy, Seibert, & Hogan (1984) in a study similar to the study by Bates and her colleagues (1979). Data collected with the developmentally delayed children were similar to those found by Bates. In summary, for the 8- to 13-month (mental age, MA) group, means-end performance and object play were significantly correlated with the nonverbal communicative abilities of Initiating Joint Action and Initiating Behavior Regulation (categories that correspond to declaratives and imperatives; Bates et al., 1979). Object play skills were also highly correlated to social interaction. Results indicate that early communication skills were correlated with MA; however, social interaction skills were not.

Additional studies by Kahn (1982, 1984) demonstrate both theoretical and practical implications for children with severe handicaps. Twenty-four children with profound handicaps (no sensory impairments) were involved in the study. The children were randomly assigned to three groups. One group received speech training after training for

object permanence concepts; one group received speech training after receiving training for means-end concepts; and the third group received only speech training. Of the children receiving object permanence training, 62 percent produced some words. Of the group in the means-end training, 75 percent produced speech, but overall progress clearly exceeded that of the first group. None of the speech-only group used words. Followup data indicated that both groups receiving cognitive skills training retained their progress to a significant degree. These results indicate that direct training can affect the acquisition of some cognitive skills in children with severe/profound disabilities. Examinations of sensorimotor skills, MA, and language performance conducted by Dreifuss (1983) with severely handicapped children showed that symbolic language was not present unless sensorimotor skills were sufficiently developed. He also found that expressive language scores were significantly below receptive language scores. Out of the sensorimotor complex, both gestural and vocal imitation were the lowest skills to be demonstrated by the children.

There is general agreement that delayed and nondelayed children, matched for mean length of utterance, demonstrate comparable levels of semantic and syntactic development (Coggins, 1979; Ingram, 1972; Rondal, 1978). The results of these studies suggest that, overall, children with language impairments and retardation learn language form and content in the same general progression as children without delays, only at a slower rate and often at a lower ceiling. A more recent study by Mahoney, Glover, and Finger (1981), however, indicates that young children with Down syndrome performed lower than their overall sensorimotor scores would indicate in the areas of vocal imitation, receptive language, and in the acquisition of first words. These findings tend to agree with those of Bates et al. (1979a), in that children may have to reach specific levels of imitation, tool use, and gestural communication before symbolic communication can occur. Additionally, their findings indicate that children often imitate what they comprehend. These results, in conjunction with Nelson's (1981) report that comprehension is one of the major predictors of language acquisition, seem to support the Mahoney et al. (1981) findings. Lower vocal imitation may be a result of lower receptive language acquisition in addition to sensorimotor functioning.

The Development of Communication Functions

Recently, a number of studies have investigated the development of communication functions or uses (pragmatic ability) in relation to other linguistic abilities (mean length of utterance and semantic relations) of children with language impairments (Fey, Leonard, Fey, & O'Connor, 1978; Fischer, 1983; Leonard, Camarata, Rowan, & Chapman, 1982; Rowan & Leonard, 1981; Snyder, 1975) and with children having Down syndrome (Coggins, Carpenter, & Owings, 1983; Marshall, Hegrenes, & Goldstein, 1973; Owens & MacDonald, 1982). The study conducted by Leonard et al. (1982) examined the communication functions of two groups of children—those with language impairments and those without disabilities. The children with language impairments appeared to exhibit communication functions that were consistent with their level of lexical development. One difference was noted in that naming was used more frequently by the children without disabilities, and answering was used more frequently by children in the other group. Results in a study conducted by Rom and Bliss (1981) also show that language-delayed children use the "answering" function frequently, but "describe and acknowledge" less frequently than their nonhandicapped peers.

Overall, studies investigating the development of communication functions (e.g., request, label, protest, answer, etc.) specific to children with Down syndrome have revealed no significant differences between children with Down syndrome and children without apparent handicaps. Studies that matched children on mean length of utterances

at different stages (Owens & MacDonald, 1982) and on cognitive and language levels (Coggins, Carpenter, & Owings, 1983) confirm these results. Additionally, a case study conducted by Owings (1983) shows that the protest function could be used as a strategy to train a requesting function with a delayed preverbal child. The child also generalized to other functions. However, populations with more severe handicaps may not demonstrate generalization without more specific training.

Studies investigating communicative ability with populations with hearing impairments (Curtis, Prutting, & Lowell, 1979); visual impairments (Anderson, Dunlea, & Kekelis, 1984; Gillis, 1984; Kitzinger, 1984); autism (Bernard-Opitz, 1982; Curcio, 1978; Prizant & Duncan, 1981; Prizant & Rydell, 1981; Wetherby & Prutting, 1984), and severe/profound mental retardation (Cirrin & Rowland, 1984; Lobato, Barrera, & Feldman, 1981) have produced mixed findings in regard to (a) the level of prelinguistic and linguistic ability compared to sensorimotor stage functioning and (b) the types of communication functions relevant to prelinguistic and linguistic ability. Subsequently, there seems to be general agreement that children with similar linguistic and cognitive abilities demonstrate comparable communicative behaviors that serve a number of different functions (e.g., request, protest, answer, request information). However, children with severe handicaps who are at the prelinguistic communication level appear to be rather restricted in their use of communication functions, compared to the results with nondelayed children (Bates, 1976; Halliday, 1975; Sugarman, 1977).

The Sequence and Use of Prelinguistic and Linguistic Communication

Even though speech and signing are not the only communication systems available to young children with sensory impairments, studies specific to the visual-gestural systems (visual-sign) and the aural-oral (hearing-speech) systems are much more prevalent than tactile-kinesthetic (touch-sign, object-tactile) systems. Often, tactile-kinesthetic systems, such as touch cues, touch signs, object systems, morse code, and braille are the primary communication systems of persons with severe sensory impairments. Yet, data are not available that trace the development of symbolic systems other than speech-words or signs. Moreover, the development of signs as an emergent language system is just beginning to be investigated more systematically.

Volterra et al. (1979) found that children do not produce symbolic gestures without acting on the objects. They found that it was no easier for children to acquire an arbitrary gesture than to acquire an arbitrary sound. In fact, Bretherton et al. (1981) suggest that the decontextualization of the symbol and referent may be more difficult in the gestural modality than in the vocal modality. These findings may be applicable only for hearing children reared in an auditory environment. Prinz and Prinz (1979, cited by Miller, 1981) followed the development of a hearing child reared with a hearing parent and nonhearing parent. Findings reveal that the child developed manual and verbal English at the same rate. Studies investigating the acquisition of manual signs with children who are deaf report equivalent acquisition (Newport & Ashbrook, 1977) or more rapid acquisition of manual communication. Studies by Bonvillian and Nelson (1978) and Wilbur (1979) also reported that hearing infants exposed to manual signs begin to express manual signs before vocal words. A series of articles (Bonvillian & Orlansky, 1984; Bonvillian, Orlansky, & Novack, 1983; Bonvillian, Orlansky, Novack, & Folven, 1983) reporting on a longitudinal study with young children of deaf parents present data that indicate that the majority of children examined expressed linguistic performance in advance of their cognitive skills (8-9 months). Findings indicate prelinguistic gestures (pointing, giving, showing) did not occur prior to linguistic-sign development, but rather co-occurred with the frequency of each being directly interrelated. However, recent findings by McKinney (1983) show that nonverbal communi-

ation skills and functions expressed by hearing-impaired youngsters were developed prior to linguistic forms.

Cirrin and Rowland (1984) assessed the communicative behaviors and functions of 15 nonverbal youths with severe/profound retardation. All of the youths, even those with severe social and cognitive impairments, exhibited a number of communication behaviors and functions. The youths were divided into low and high communicators based on the frequency of use of communicative behaviors. The low communicators used fewer types of communicative functions (requesting action/object, protesting). This group also demonstrated fewer and less conventional communicative acts (pushing away, extending object). The high communicators were more flexible and diverse in their use of the types of conventional prelinguistic and linguistic (signs) behaviors and in the functions those behaviors expressed. The investigation by Lobato et al. (1981) also included youth who were older (mean of 13 years) and institutionalized. The study examined communicative behavior in sensorimotor Stages IV, V, and VI. Their data support the results of Sugarman (1977) and Bates et al. (1979a), indicating an interdependence between cognition and communication. However, Lobato et al. (1981) found that there was variability in the communicative functions in that only approximately 23 percent of the youths used equivalent stage communicative gestures for both declarative and imperative functions. The remaining youth demonstrated better performance on the imperative than on declarative functions. Snyder (1978) also reported that children with language delays demonstrated higher performance levels on the imperative (request, demand) tasks. Results of a 3-year longitudinal study of the prelinguistic behaviors of 20 severely/profoundly handicapped children collected in weekly snack and freetime settings (Stremel-Campbell, manuscript in preparation, Note 1) indicate that only protest and requesting object and action functions were demonstrated by the children. The majority of prelanguage behaviors used included direct manipulations of the adult or manipulations of the object (extending, pushing away). Only two of the children evidenced a pointing response. An overwhelming majority of the behaviors were used to request food items or direct social interaction (hug-tickle). These data indicate a restricted use of communicative functions, types of gestures used, and of the content.

Studies in which the gestures of autistic children were examined (Curcio, 1978; Wetherby & Prutting, 1984) revealed that factors other than cognitive development may play an important role in language acquisition. Curcio (1978) found that children with autism display request, refusal, and greeting, but typically do not demonstrate pointing or showing to express comments or to direct another's attention to referents. The data indicate that many of the gestures used by the children represent contextually restricted communicative behaviors (manipulating the adult's hand). The results of a study by Wetherby and Prutting (1984) are consistent with Curcio's findings. Data sources of cognitive assessment and communication assessment show that their subjects demonstrate strengths in tool use, but weaknesses in symbolic play and conventional gestures. Additional findings indicate that the requesting function (imperative) is utilized significantly more frequently than the commenting/label (declarative) function. Wetherby and Prutting's (1984, p. 376) concise statement may accurately describe the communicative behavior of nonverbal children and youth with more severe handicaps: "The children were proficient in figuring out how the environment works, but deficient in sharing that knowledge with others or in acquiring that knowledge from others."

Many of the previous studies did not investigate different communication performance across different persons or different environmental contexts. A number of authors (Bernard-Opitz, 1982; Schuler, 1979) stress the importance of studying communicative performance as a function of the communicative context. Future research

studies examining performance must take into consideration that children communicate differently with different people across different activities in different settings. Furthermore, many children with handicaps have been in intervention programs for a number of years. The effects of specific types of interventions and the effects of institutionalization on communicative performance need to be considered, in addition to the child's cognitive and social abilities. For example, young children without hearing impairments do not use symbolic gestures (hand to mouth to represent drink) to communicate; children with hearing impairments seem to acquire symbolic gestures (signs) quite readily. These findings perhaps point out the effects of specific training, parent input, and the adaptations made by children with disabilities.

Differences in Mother-Child Interactions with Children who are Disabled

The previous review of the relationship of mother's interactions and speech to the child's linguistic development points to the important role that these interactions play in the acquisition of a language system. Bruner (1983) and Wells (1981) provide an excellent account of how mothers provide "scaffolds" and "formats" for enhancing the child's language development. The possible impact of a handicap on mother-child interactions is described by Bell and Harper (1977) as one in which the response of parents to the handicap alone may evoke specific nonadaptive parental behaviors. Indeed, many parents of children with handicaps will need to use "different" strategies in interactions. It is essential to determine which strategies are adaptive and which are nonadaptive. We cannot assume that strategies are nonadaptive simply because they differ from the norm. It is also difficult to determine the cause-effect relationship of mother-child interactions or how each partner must modify interaction patterns to make them successful. As Fraiberg's (1971, 1977) research indicates, mothers of children with disabilities may have to be taught even more adaptive strategies. Moerk (1976) points out the importance of providing opportunities for language-teaching sequences within positive interactions. Studies also indicate that early acquisition of referential speech is influenced by a cognitive-linguistic match in child-mother interactions (Cross, 1978; Newport, Gleitman, & Gleitman, 1977). Caregivers of children without handicaps focus their speech on what the child is focusing on or is interested in (Mueller, 1972; Phillips, 1970; Snow & Ferguson, 1977). It is clear that the mother's speech is highly synchronized with the child's behavior (Collis, 1977; Collis & Schaffer, 1975; Messer, 1983; Murphy, 1978) in ongoing social interactions.

What implications do these findings have for children who do not interact with their physical world; who are not able to engage in eye gaze; who do not have the motor ability to reach and grasp? Do mothers need to learn to monitor a handicapped child's focus/behavior more closely and learn that the child's unconventional forms of behavior do have meaning? The following studies point out that parent interactions with children who are disabled demonstrate some major differences from the "norm." However, only a few of the studies discuss whether these adaptations are functional or what strategies could be used to make these interactions more positive (Fischer, 1983; Kekelis & Andersen, 1984).

Marshall et al. (1973) examined the communicative performances between mothers and their children (handicapped and nondelayed) using Skinner's (1957) verbal operants. Two groups of children were matched for chronological age but not linguistic ability or mental age. The results suggest that mothers of children with retardation "manded" (demanded and commanded, requested, gave directions) with a much higher frequency than the mothers of nondelayed children. The nondelayed children used tacts (labels), mands (demands, commands), and intraverbals (questions) more frequently than the children with delays. The delayed group used a higher proportion of echoes (imitations of previous

words or utterances). Surprisingly, based on the data presented earlier, both groups used more tacts (labels) and intraverbals than mands (imperatives). Since Skinner's operants are broad categories of functions, it is difficult to draw direct comparisons between this study and the previous studies.

The caregiver-child interaction patterns of prelinguistic children with severe handicaps and prelinguistic children without disabilities were compared in a study by Koenig & Mervis (1984). The children were matched on means-ends performance (Stage V). Whereas few differences were found in the prelinguistic behaviors between the two groups of children, differences were found between the groups of caregivers and mothers. The caregivers of the children with handicaps produced few referential utterances when the children focused on an object. Additionally, the caregivers provided fewer object demonstrations. It should be pointed out that the caregivers were not the natural mothers. However, the study did indicate that assessment of the child's environment is necessary in order to determine if the environment is optimal for advancing the child into a referential language-system. Cunningham, Reuler, Blackwell, and Deck (1981) studied younger children who were handicapped, matched with children without handicaps. Both groups were matched on receptive vocabulary scores and divided into high and low MA groups. Results show that the children with handicaps were less interactive and less responsive than their matched peers, but that they were no less compliant than the nonhandicapped group. However, the mothers of the handicapped children used more commands and were less likely to provide positive feedback for cooperative interactions. The mothers of the handicapped children also initiated fewer social interactions. Subsequently, the low frequency of social interactions between mother and child decrease the number of opportunities for communication and language (Moerk, 1976). Results obtained by Eheart (1982) are similar to those found by Cunningham et al. (1981). She found that children with handicaps were less responsive to initiations and initiated less than half as many interactions as did the children without handicaps. Her findings also suggest that the mothers of children with handicaps were more directive and dominated the interactions. However, Eheart found that those mothers initiated almost twice as many interactions as did the mothers of the nonhandicapped children, findings that are not consistent with Cunningham et al. (1981).

Studies of mother-child interactions with populations who are sensory impaired also suggest that mothers of children with hearing impairments (Goss, 1970; Henggeler & Cooper, 1983; Schlesinger & Meadow, 1972; Wendell-Monnig & Lumley, 1980) and with vision impairments (Kekelis & Andersen, 1984; Rowland, 1984a) may interact in ways that are not conducive to prelinguistic and linguistic growth. Interestingly, interaction patterns of mother-infant and mother-preschooler pairs (in mother and hearing-impaired child dyads) demonstrate that the quality of interactions may decrease as the child matures (Wedell-Monnig & Lumley, 1980). These authors found that infants were only less responsive when the mothers did not stimulate them. Mothers of the younger children initiated more interactions than did mothers of older children. However, as the children became older, they were less interactive with their mothers, and their mothers were less interactive with them. Similar results were obtained by Henggeler and Cooper (1983). They found that preschool children with hearing impairments were less compliant and less responsive than their hearing counterparts. Consequently, mothers of the hearing-impaired children spent less time in interactions and were less attentive and less responsive than were the mothers of the hearing children. However, Wendell-Manig and Lumley (1980) did not find that the mothers of hearing-impaired children were more directive.

In a study investigating the preverbal communication system of blind infants, Rowland (1984a) found that, while the frequency of the infant's vocalizations was similar

to that of sighted infants, the vocal patterns did not show clear patterns of responsiveness. In addition, Rowland investigated mothers' interactions with visually impaired infants in videotaped interactions. She found that mothers did not respond reliably to the infant's gestures or vocalizations. Fraiberg (1971, 1977) found that in the absence of differentiated facial signs, blind infants use expressive hand signs. However, without specific training, only 2 of the 10 mothers in her study responded to the infant's unconventional signals. Persons with visual impairments and mental handicaps seem to exhibit communication difficulties from the preverbal stage of communication, including imitation, turn taking, joint attention, and object manipulation.

Mueller (1972) discusses three factors that facilitate responsiveness of mother-child dyads: maintaining eye contact, responding contingently to the listener's turn, and attending to the interest of the partner. Children with severe vision impairments may be more likely to be considered "unresponsive" based solely on their lack of vision. The concentrated efforts of Andersen and her colleagues have provided a database for the interaction patterns of children with vision impairments and their families (Kekelis & Andersen, 1984). Their approach is interesting in that it accounts for not only the quality of interactions, but the effects of modification strategies, the rationale for strategies, and the training of more effective adaptations or strategies. In summary, they found that mothers of children with vision impairments, when compared to mothers of sighted peers, use more directives (commands); use fewer statements of descriptions of objects, actions, or events of the present environment; use a high proportion of labels without elaboration; use a large number of child-centered topics; and introduce new topics with high frequency. Interestingly, these authors discuss the reasons for the modifications made by the mothers of the visually impaired youngsters. For example, children who are blind are also learning to master other skills that may be delayed (i.e., orientation, locomotion, object manipulation, self-help skills). The extremely frequent use of directives is a modification also used by mothers of children with cognitive disabilities. The authors (p. 61) conclude, "Unfortunately requests for action do not generally solve the problems that motivate them." Indeed, there is a large body of data that indicates that the maternal use of a high proportion of directives may (a) influence language acquisition in a negative direction (Cross, 1978; Field, 1977; 1980; McDonald & Pien, 1982), (b) decrease the frequency and complexity of spontaneous speech (Hubbel, 1977) and, more specifically, (c) cause a slower rate of vocabulary acquisition (Nelson, 1973; Snow, 1979). A high rate of requests for action or directives may be especially ineffective (and negative) when the partner's speech does not match the focus of the child.

Research on the language development of young children with handicaps indicates that children with moderate handicaps learn language in a sequence and manner similar to children without handicaps. Studies by Snyder (1975) and Mahoney et al. (1981) reveal that some differences in development may occur. It is important to note that children with handicaps may also present dramatically individual differences with dramatically different social-familial experiences and intervention programs. Additionally, many children with Down syndrome and language delay may also exhibit mild auditory and/or visual impairments. Deficits in perceptual development may affect social development as dramatically as they affect cognitive development. The dual deficits in both social and cognitive development create the need for more individualized assessment and intervention procedures.

The limited research findings with children with more severe and profound handicaps reveal that these children tend to demonstrate somewhat different developmental learning strategies. For example, communication functions and the types of prelinguistic behaviors seem to be somewhat restricted. Additional data with younger

children (6-8 months) without handicaps may point out that young children also exhibit more restricted forms than earlier research indicated, but that they progress through early communication acquisition very rapidly. Therefore, it is more difficult to document these differences in the sequence of normal development.

Due to the passage of Public Law 99-457 including legislation for toddlers and preschool children, most children with handicaps, who are being assessed, are acquiring communication and language in intervention programs. Therefore, it is difficult to determine if children with more severe handicaps learn differently due to their handicapping condition because of the types of intervention procedures, or because of environmental interactions. Perhaps additional data with children without apparent handicaps are needed to determine more adequately similarities and differences among these young children.

The Development of Emergent Language in Children with Dual Sensory Impairments

Jensem (1979) reports that approximately 75 percent of persons characterized as deaf-blind display cognitive deficits and that approximately 65 percent have at least one additional handicapping condition. Developmental data for deaf-blind children and youth (7-21 years) from five states were analyzed across a 3-year period by the Mountain Plains Regional Center for Services to Deaf-Blind Children (Snyder & Yoshinaga, 1982). Results indicate that the children/youth made progress in perceptual development and daily living skills, but made extremely limited progress in language and social development. The vast majority of children with a combination of hearing and visual impairments experience severe communication difficulties (McCormick, 1984) and seem to make limited progress in developing language skills. The few studies reporting the communication/language progress of persons with dual sensory impairments have been conducted primarily with older persons (Curtis, 1975) or include only case studies (Yarnall, 1980). Research data investigating the prelinguistic communication systems and the emergent language systems with young children who are deaf-blind are virtually nonexistent. Data specific to the rates or stages of language development with hearing-impaired children (Brown, 1977; Moores, 1977; Schlesinger & Meadow, 1972; Wilbur, 1976) and visually impaired children (Andersen, Dunlea & Kekelis, 1983; Fraiberg, 1971, 1977; Kekelis & Andersen, 1984; Rowland, 1984a; Urwin, 1979; Warren, 1977) are also somewhat limited. Overall, results from these studies suggest that while there may be some similarities on a surface level, the communicative interaction patterns and the process of reaching specific milestones may be quite different.

Research specific to the development of language in children with visual impairments shows conflicting results. Whereas Urwin (1979) and Landau (1983) propose that parallels and similarities in language acquisition exist between children with blindness and other sighted children; Warren (1977, 1978) contends that even though the majority of children with visual handicaps do eventually use language similarly to their sighted peers, they initially demonstrate significant differences in the rate at which they acquire language. Recent research conducted by Andersen and her colleagues has demonstrated that there are basic differences in the ways children with vision impairments acquire language (Andersen et al., 1984; Dunlea, 1983). These authors contend that vision does play an important role in cognition and social interactions and language acquisition, and that the analysis of data must include the use of language in context. In summary, Andersen et al. (1984) found that the participants of their study (a) did not overextend their words to refer to multiple referents as sighted children do; (b) used primarily object names and action words in their 100-word vocabularies; (c) did not "create" new words; (d) used restricted action words for self-actions; (e) did not drop early words; (half of the words did not generalize to new contexts; used many linguistic forms that

were tied to food or specific persons); and (f) lacked a "perspective-taking" ability (pronoun reversals, use of questions as statements). These findings indicate that children with visual impairments seem to rely heavily on the use of imitation as a strategy (Urwin, 1983); often missing the true semantic and pragmatic aspects of language within social interactions. Even though the child's imitations may be functional and not without meaning (Kitzinger, 1984), often these meanings and intents cannot easily be shared with the listener because they vary from the typical "adult form." Wills (1979) implies that these children may need to be trained to structure their experiences and be provided with appropriate social interaction when seemingly meaningless forms occur.

With the exception of Stein's (1982) review of language development of deaf-blind children across a 7-year period, the majority of the literature, specific to children with sensory impairments, concentrates on the numerous communication systems available to deaf-blind children and adults (Dinsmore, 1959; Jensema, 1979; Kates & Schein, 1983). Kramer and Rosenfeld (1975) list four criteria for consideration in selecting communication systems for persons with dual sensory impairments. Those criteria include (a) the age of onset and severity of the hearing impairment and (b) age of onset and severity of the visual impairment. The age of receiving corrective lens and amplification and the severity of a mental disability would also seem to be extremely important variables in selecting a specific symbolic language system. Jensema (1981) conducted a national survey with teachers of sensory-impaired children. Her results indicate that the severity of visual impairment is more reliable than intelligence quotient as an indicator of a preferred method of communication. Students with even moderate-to-severe vision impairments preferred visually presented gestures (signs) over aural-oral approaches, according to the teacher's reports. Approximately 20 different systems (e.g., fingerspelling, cross-code, morse code, one-hand/two-hand touch signs, Tadoma, bliss symbolies, palmwriting, etc.), excluding different types of electronic augmentative systems, are available as communication systems for persons with sensory impairments (Kates & Schein, 1980). As a child with sensory impairments develops language, he or she may know and use as many as five different systems (Yarnall, 1980). Curtis (1975) studied 20 deaf-blind children and found that auditory-receptive and oral-expressive skills were the lowest language skills demonstrated, with visual-tactile-kinesthetic based systems being superior to oral-aural systems. Additional results indicated that the majority of children were most deficient in communicating in unstructured situations. These data stress the importance of familiar and routine situations for early intervention and also more active generalization strategies to facilitate generalization to more unfamiliar situations.

A number of authors discuss the importance of the social and cognitive aspects of development and the importance of social-cognitive skills in the development of early communication for handicapped (McLean & Snyder-McLean, 1978; Rowland & Stremel-Campbell, 1987) sensory-impaired youngsters (Kennedy, 1974; Rogow, 1980; Seibert & Hogan, 1981; Shields, 1972; Stillman & Battle, 1984). Kennedy (1974) defines two components important to the acquisition of communication. These are the awareness of communication of others and consistent responses of adults to the behaviors that communicate. However, documents and articles discussing the development of communication and emergent language systems with children identified as deaf-blind have not included supporting data.

In addition to the use of more precise measurement systems, a number of other variables must be addressed before more individualized communication and language systems for deaf-blind infants and children can be developed. More precise assessments of hearing acuity, visual acuity, tactile sensitivities, and cognitive development need to be conducted and clearly documented for individual children with sensory impairments

before we learn how these children acquire a prelinguistic and emergent language communication system. The review of the literature with children who are nondelayed or who do not exhibit dual sensory impairments perhaps poses more questions than answers. However, the literature does point out that specific levels of interaction and knowledge of the social and physical environment are usually present before most children show prelanguage communication skills and language skills. Other important points to consider are the gradual progression of emergent language acquisition, the possible interdependence of seemingly nonrelated skills, and also individual differences in acquisition styles among all children. The literature with children who do not exhibit disabilities also emphasizes that the development of communication functions/uses and of prelanguage communication needs to be addressed prior to issues specific to content, modality, and form.

Summary and Conclusions

The overall review of prelanguage and emergent language indicates that two major questions need to be addressed: (a) how the child with visual and hearing impairments is currently communicating, in terms of diversity and frequency; and (b) how important persons within the child's environment are communicating with the child. Current models of communication and language development indicate that components other than a productive language system need to be addressed. Early affective behaviors in mother-child interactions seem to be extremely important prior to the child's use of an intentional communication system. The child's primary communication model (mother/caregiver) must respond initially to the child's early behaviors as if they were communicative. Therefore, early intervention programs may focus on changing the behavior and interaction patterns of the primary language models rather than solely targeting the child's behavior. The caregiver must also learn to respond contingently. Continued assessment of the child's sensory systems is necessary in order to determine what environmental adaptations may be necessary so the child can respond to the mother. Consequently, early behaviors and reciprocal interactions within natural routines need to be assessed and programmed prior to targeting a prelanguage communication system as discussed by Siegal-Causey and Downing (1987).

From the literature, it may be seen that children without handicaps use frequent and diverse prelanguage communication prior to learning a symbolic language system. The communication system gradually becomes more intentional, and children are able to express a variety of different intents (requesting object, requesting action, protesting, requesting attention) before saying their first words. In all likelihood, it will be necessary to determine adaptations for the deaf-blind child who is unable to use pointing or vocalization due to sensory or motor impairments. Additionally, the object-use, play, imitation, and tool-use skills of each child need to be examined to determine how the child is interacting with the physical environment. The social turn-taking skills involved in prelanguage communication also need to be addressed to determine if the child is recognizing the listener as an agent who can get something done for him or her. A number of children with severe handicaps seem to lack the reciprocity of communication. The child's comprehension or recognition of the prelanguage acts/behaviors from other persons is an important aspect. The child must use nonverbal environmental cues in order to learn the meaning of the linguistic symbols or concepts directed to him. The quantity and quality of communication and opportunities from other persons (parents, teachers, siblings, and peers) also need to be addressed so that effective communication exchanges are developed within natural contexts.

The perspectives of individual differences, distancing the symbol from the referent, and selecting first words are important as the child with deaf-blindness is learning to use

concrete symbols in play and in communication. Using concrete objects and gradually introducing more abstract symbols (in abstract, stationary systems or in gesture-sign systems) may be crucial to the development of both prelanguage and language intervention programs. Both imitation and recognition (comprehension) of symbols seem to be important constructs in training symbolic behavior.

Existing knowledge and interventions for children who are deaf-blind have not typically described the quantitative similarities and differences that exist on a normal developmental continuum. Although it is recognized that the child with deafness and blindness may indeed require interventions that differ from the normal development sequence, there is a need to (a) continually examine how normal children develop communication skills, (b) examine the efficacy of current intervention practices, (c) adapt sequences of normal developmental progression and current practices for children who are sensory impaired, and (d) evaluate the effectiveness of the sequence of skills being trained, the content and context of "what" is trained, and the procedures used. Only then can we evaluate the effectiveness of broader intervention systems for children who are sensory impaired.

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IX. Contingency Intervention

by

Philip Schweigert

Microswitch and microcomputer technology offer educators important tools in training children with severe handicaps. Specifically, this technology can be used to increase opportunities for these children to participate actively in the environment. At the level of contingency awareness, such application fosters an understanding of the relationship between the child's behaviors and contingent results in the nonsocial (object) world. Also, through this intervention modality, the visual and auditory features of the objects in the interaction are highlighted. To illustrate, in working with a particular child, with a limited response repertoire who interacts little with the object world, it is ascertained that the child does display voluntary, but infrequent, lateral head movement. A microswitch is placed to the side of the child's head within the range of motion, and a switch is then attached to a toy train with visual (movement) and auditory (music) features. The child's head movements cause the switch's closure, thus starting the train. Increases in head movement increase the reinforcement (i.e., the train starting), and engender an awareness on the part of the child that something he or she has done has caused the train to move and make sounds.

Although such opportunities with response-contingent feedback are important for the child with deaf-blindness, engineering of these experiences may pose some problems. These children have obvious limitations in perceiving and being reinforced by auditory and/or visual feedback. With reduced sensory capabilities, such a child is extremely limited in interaction with the physical and social environment (see Stremel-Campbell, this volume). Many children with both hearing and vision impairments have additional handicaps, such as mental retardation or orthopedic limitations (Orlansky, 1981; Roberts, Helmstetter, Guess, Murphy-Herd, & Mulligan, 1984; Ward, 1981). Consequently, these children may be severely impaired in the awareness of their world and in understanding their ability to control environmental outcomes (i.e., stimulus-response relationships).

Given these limitations, it is indeed unfortunate that there is little research in the professional literature regarding the application of the microswitch and microcomputer technology to fundamental social interaction and communication development for children with deaf-blindness. This type of information is of great importance to educators and caregivers who seek to increase a child's fundamental social communication skills. Can this kind of technological intervention facilitate socially communicative behaviors between caregivers and children with deaf-blindness? If so, how can these interventions be used to improve these interactions? Clearly, there is considerable need to examine the relationship of contingency awareness through microswitch and microcomputer technology in the communication development of children with deaf-blindness.

The purpose of this paper is to provide a synthesis of information on this topic. First, the theoretical background underlying the concept of contingency awareness and its importance in infant development is reviewed. Second, contingency-awareness studies involving infants and children who are disabled are discussed. Third, potential applications of microswitch and microcomputer technology to facilitate social and communication development in the target population are suggested.

Theoretical Background

The infant is not a passive agent in the environment (Brinker & Lewis, 1982a; Hulsebus, 1973; Lewis, 1984). Rather, the infant is an "... active information processing organism, initiating transactions with the environment and in turn being influenced by these transactions" (Yarrow, Rubenstein, Pederson, & Jankowski, 1972, p. 217). Essentially, the infant is constantly interacting with the surroundings and is capable of perceiving the relationship between his or her actions and corresponding environmental events. The realization of the association between behavior and environmental outcomes is essential for future learning.

The goal of this section is to review selected studies that are particularly pertinent to the primary subject of this chapter. These investigations are divided into two groups: (a) contingency awareness and (b) social contingencies as related to the caretaker-infant dyad. A synthesis of this discussion and implications relevant to the education of the target population is offered as well. For a thorough overview of contingency awareness and operant conditioning the reader is referred to Hulsebus (1973), Millar (1976), and Thurman (1979).

Contingency Awareness

The following section describes the pitfalls that are experienced by young learners in their first 3 months of life in discovering contingency awareness. Despite these problems, several studies demonstrate that such opportunities for the infant to detect the relationship between his or her behavior and the surroundings are possible. Furthermore, it is pointed out that exposure to response-dependent feedback and the chance to develop contingency awareness does have significant positive impact in future learning.

Watson (1966) hypothesizes that from birth infants have the capacity for contingency awareness. That is, in addition to being able to produce rewards in their environment, they are capable also of detecting and understanding the contingent relationships that exist between their behavior and corresponding stimuli. During the first 3 months of life, however, this avenue for learning is hampered by two factors: the short term memory limitations of the infant and the child's limited ability to make responses with a sufficiently short recovery speed that enables reinforcement to be repeatedly elicited directly from the environment. He has termed these first 3 months of life "a period of natural deprivation" (1966, p. 123). An example of this deprivation is shown by the infant who causes a mobile to move by hitting the crib with one arm. Under natural conditions the contingent relationship between the arm movement and the mobile moving is undetectable, because, by the time the child can repeat that movement, the relationship has been forgotten.

Watson proposes, though, that even during the period of natural deprivation one might be able to provide artificial contingent conditions that are within the parameters of the infant's memory and motor responses. In this way, the infant would be able to discern the contingent relationship between response and reinforcement. An example of this type of contingent reinforcement arrangement is provided by Watson's (1966) study involving his 2-month-old son. In this investigation Watson presented his left and right hands to the child in the shape of a fist. He would repeatedly open and close his right hand only when the infant visually fixated on it. After three sessions of this contingent arrangement it was noted that the infant increased his fixation on the right responsive hand. In the following sessions, contingencies were changed to the left hand (i.e., Watson opened and closed that hand when the child fixated). Over time the infant

demonstrated a clear preference for fixating on the left appendage. Similar demonstrations of contingency awareness under artificial conditions are found in studies by Sigel and (1965) and Stern and Jeffrey (1965) (as referenced by Watson, 1966). These investigations involved infants who were 0 to 1 month of age. Head turning and non-nutritive sucking were utilized as the responses to be reinforced by the mediating adult. In both studies, increases were found in these targeted behaviors.

From the results of these three studies Watson (1966) suggests that artificial contingencies can be provided to infants prior to 3 months of age, potentially offsetting the period of deprivation. It is reasoned that such manipulation of the child's environment can have a dramatic impact on development.

Other studies support this contention. Ramey and Watson (1972) conducted an investigation that examined the development of contingency awareness in 40 infants who were 2 months of age. Each infant was studied at home and the child's head movements were chosen as the target response. A mobile was suspended over each child's crib. For the 18 infants who were assigned to the experimental (contingent) group the mobile was controlled by a pressure-sensitive switching device placed in the pillow; the movement of the infant's head against the pillow activated the mobile. This movement was considered to be within the limits of both the infants' motor-response repertoire and memory of the two events (the temporal limits of the children were estimated to be between 5 to 7 seconds). In addition, two control groups of 11 infants each were formed. For the first control group, the noncontingent or "auto-mobile" group, the movement of the mobile was automatic and totally unrelated to any infant behavior. The second control group was presented a "stable" or non-rotating mobile. For all three groups the amount of head movement was tallied on an event counter, and recorded by the child's mother at the end of each experimental session.

In comparing the data across the 14 days of the study, the infants in both contingent groups demonstrated marked increases in head movements to activate the mobile. Conversely, the infants in both control groups did not show a comparable increase in movements, nor did the performance of these two groups (i.e., no stimulation, and noncontingent stimulation) differ significantly between themselves. The results of this study suggest that the infants in the experimental group increased their head movements on the pillow, not because of the turning mobile display, but because such stimulation was contingent on their activation of the switch. Additionally, the findings demonstrate that infants are capable of instrumental learning by 2 months of age and that opportunities for response-contingent feedback are possible in the home.

Finklestein and Ramey (1977) conducted three studies to look at the importance of response-contingent stimulation to later learning tasks. Thirty-four infants who were between 4.5 and 8.5 months of age were involved in the three investigations. The first two studies (Study 1 and Study 2) compared children from contingent and noncontingent stimulation groups on the ability to learn different response-consequence contingencies in subsequent activities. Study 3 was designed to determine whether or not prior experiences with contingent stimulation would improve a child's contingency learning ability in complex learning tasks. In this last study, one infant group received stimulation contingent upon vocal responses, and a second group received no stimulation during baseline or treatment plans. A second phase of this study examined the performance of both groups on a lever-response task in the presence or absence of contingent stimulation.

Results from Study 1 and Study 2 indicate that those children with prior experience controlling stimulation learned more effectively in new response-stimulus situations than

did their control group counterparts. Likewise, data from Study 3 show that the infants with previous contingency experience demonstrated the ability to discriminate in the experimental tasks, whereas subjects without such background did not demonstrate these behaviors. The authors conclude that opportunities for controlling stimulation are important features of the infant's environment. Moreover, they propose that such exposure may facilitate the infant's understanding and development of techniques for interacting with the world.

In a replication of this research, Ramey and Finklestein (1978) found similar results with regard to response performance. Once again those infants in the contingent group showed increased attention not only to the stimuli, but also to the response strategies they employed to bring about these events. This was not the case for infants comprising the noncontingent group, who attended primarily to the stimuli only. Subsequently, those infants having prior experience with stimulation contingent upon their responses in the home were able to generalize this learning to a laboratory setting. The other (no-stimulation) group was unable to demonstrate generalization of this learning.

More recently, Dunst (1984) examined visual attention of 2- to 3-month-old infants under response-dependent and response-independent conditions. As in Ramey and Finklestein's research, it was found that visual attention was enhanced most under contingent-stimulation conditions. Dunst also discovered that, while noncontingent stimulation (i.e., stimulation independent of the infants response) did temporarily increase this targeted behavior, this increase was directed at the stimulus only. Contingent stimulation, however, generated increased visual attention to the child's own response performance as well as to the stimuli. Dunst concludes that an environment that overemphasizes noncontingent feedback may, in effect, be creating a sense of helplessness on the part of the child since he or she cannot control the environmental events.

For young infants, this awareness of the ability to control events within their surroundings is crucial. Furthermore, it is the detection of a contingent relationship between behavior and environmental outcomes that serves to motivate the infants to respond (Watson & Ramey, 1972) and attend to their own behavior as well as their surroundings (Dunst, 1984; Ramey & Finklestein, 1978). In spite of the restraints of a limited short-term memory and motor response repertoire, Watson (1966) argues that opportunities for developing this contingency awareness can be provided to the child at a very early age. The studies discussed in this section support this position. Moreover, it can be seen that such occasions to learn are important for the infant's development. Specifically, infants with prior experience with response-contingent feedback proved to be more effective learners in later contingency tasks than did children exposed to non-contingent stimulation (i.e., stimulation independent of their behavior) only.

Social Contingencies: The Caretaker-Infant Dyad

The importance of social, as well as nonsocial, response-contingent interactions for the child's social and cognitive development has been pointed out consistently in the professional literature (e.g., Stephenson & Lamb, 1981; Suomi, 1981). Accordingly, the purpose of this section is to highlight the significance of caretaker-infant interactions in the emergence of contingency awareness and the infant's cognitive and social development.

Lewis and Goldberg (1969) observed the effects of the mother-infant interaction on the infant's cognitive development to examine the importance of parent reinforcement of infant behavior (i.e., contingency experiences) in shaping motivation for future

learning. They reasoned that parent responsiveness would not only facilitate a particular behavior of the infant, but, more importantly, would also foster a feeling within the infant that his or her action can affect the environment. To investigate this hypothesis, they examined 20 dyads composed of infants who were 12 weeks of age and their mothers. To determine the impact of mother-infant interactions on the infants' cognitive development, they employed measures to assess the infants' gradual reduction in responding to a repeated signal (i.e., how quickly a child will stop or reduce responding to the repeated presentation of the same stimuli). (Note: This measure of cognitive capacity has been utilized in other studies conducted by Lewis [1967], and Lewis, Goldberg, and Rausch [1967], as cited by Lewis and Goldberg [1969]). They hypothesized that a decrease in responding to such a signal would be the result of learning on the part of the child. To test this supposition, two experimental conditions were set up. In the first component of the research, parent-infant interactions were examined. Behaviors were catalogued that included the mothers' behaviors toward their child, the infant's corresponding behavior, and the maternal response to these behaviors. The second phase of the study involved positioning a panel of lights in front of the infant. The center light was set to blink on and off for 30-second intervals. The examiners recorded the duration of visual fixation on this panel by each infant. The reduction in responding to the repeated presentation of this visual stimuli was computed for each child. Correlations between the decrement computation and the various behaviors of the mother (i.e., amount of touching, looking, holding, and smiling) were then calculated.

Overall, a positive correlation was found between maternal responsiveness to the child's behavior and the infant's response decrement. In addition, the data show that maternal responses that were contingent and quickly followed infant behavior were correlated strongly to the measure of cognitive ability (i.e., the response decrement). Maternal responsiveness appeared to be a critical feature in the dyadic relationship. The authors state, "The reinforcement of specific S-R bonds by the mother is effective in increasing the occurrence of that particular reinforced behavior; but more important, it develops within the infant the model of generalized expectancy that his behavior can affect his environment" (p. 97). In essence, it is this expectancy that motivates infants to respond in new ways to novel experiences in their environment.

Later investigations by Lewis and Coates (1980) support the findings of Lewis and Goldberg (1969). In this research, the authors conducted two studies designed to examine different aspects of maternal stimulation within the parent-infant dyad and the effects they had on the infants' cognitive development as measured by the Bayley Mental Development Index (MDI). In the first study, 96 dyads of 12-week-old infants and their mothers participated. Information gathered included Bayley scores, data on infant behavior, maternal responsivity to these behaviors, total stimulation from the mother (i.e., total number of times maternal behavior of any kind was directed toward the child), and interaction from this caregiver either initiated or in response to the infant's behaviors. In comparing the MDI scores with these different features of the mothers' stimulation toward the infant, a weak and negative relationship was found with regard to the amount of stimulation. Statistically significant correlations ($p < .05$) between maternal interaction and responsivity features and infant Bayley scores were found, however.

The second study was conducted with 189 dyads of 12-week-old infants and their mothers. Essentially, this investigation was designed to replicate the first study. The findings from this research are in agreement with the first investigation. That is, maternal interaction and the responsivity to infant behavior are positively related to the infant's current cognitive ability. Again, no relationship was found between the amount of maternal stimulation given and the MDI. The findings of this study reiterate

the importance of the social environment, and most specifically, the contingent relationship between caregiver and infant behavior to the child's development.

Ramey, Starr, Pallas, Whitten, and Reed (1975) demonstrated the positive impact of response-contingent social stimulation with nine infants ranging in age from 6 to 16.5 months. These children manifested severe delays in growth, social development, and intelligence although no organic basis for this failure to thrive was evident. The authors suspected that these conditions were a result of maternal deprivation that included inconsistent nutrition and limited physical and social interaction within the mother-infant dyad. The study was designed to compare the impact of improved nutrition and nutrition plus contingent social stimulation as reflected in developmental gains measured by the Bayley Scales of Infant Development. All children were assessed on this instrument within the hospital setting. Additionally, each child was examined in a contingency-learning task, targeting vocalization behavior. This examination was designed to determine whether or not the infants would increase the frequency and duration of their vocalization behavior in the presence of visual reinforcement that was contingent upon this targeted response.

The baseline phase of two 10-minute sessions involved placing the infant in a specially constructed crib. The frequency of nonfussing vocalizations (i.e. ". . . all vocal sounds, other than fretting and crying, produced by the infant" [p. 47]) were then recorded, and no visual stimuli were displayed during this phase. The following conditioning sessions were then carried out in all of the targeted vocalizations that were reinforced automatically by visual stimulation. First, vocalizations were automatically detected and recorded, and the observer would activate a switch to prevent recording of cries or frets. During these episodes, the response-contingent stimulation was simultaneously provided when the targeted vocalizations occurred. This visual reinforcement would then continue as long as the child vocalized; thus, both onset and duration of this feedback were controlled by this behavior. During the next phase of this investigation, the infant received specially prepared meals three times daily at home. The content of each meal and its consumption were closely monitored and recorded for each child; this continued for 4 weeks. For 5 days following this portion of the study, the two previously mentioned assessments were readministered in the hospital setting. In the 3 months that followed, the children were randomly assigned to either experimental or control groups. Both groups continued to receive the food deliveries to their homes. In addition to the special diet, the experimental group of mother-infant dyads received home tutoring. These lessons emphasized response-contingent stimulation for the infants and training for the mothers to provide such opportunities in the context of social interaction with their child. In the final part of the experiment, all children again were administered the assessment battery.

Results of the assessments given at the different intervals indicate that, in addition to the expected height and weight increases, the Bayley scores show gains for all the infants in the project. Psychomotor performance for the experimental group showed the most dramatic growth. Data from the first two conditioned-vocal-responding assessments showed very little increase in vocalization behavior in baseline and treatment comparisons. The authors conclude that there was no indication that the infants had learned the contingent relationship between their vocalizations and the visual stimulation. The third comparison between the experimental and control groups indicates a marked increase for members of the experimental group in vocalizations during conditioning. The authors state that "Both the quality of nutrition and the opportunity to receive increased response contingent stimulation in a social context contribute significantly to the remediation of developmental retardation associated with the maternal deprivation syndrome" (p. 52).

Yarrow et al. (1972) investigated different features of both social and nonsocial stimulation and their varying effects on children's development. Forty-one infants, ages 5 to 6 months, were involved in the study. Each child was in the care of a consistent primary provider. Observations and coding of both infant and caretaker behaviors were conducted in the home. The caretaker behaviors that were coded included sensory features of the social stimulation, rate of stimulus change, and whether or not the adult stimulation was contingent on the infant's behaviors. Also, the inanimate environment was observed with regard to the variety of objects made available to the infant, the responsiveness of the object (i.e., whether the object changed in some way as a result of the infant's action on it), and the object's visual, auditory, and/or tactile complexity. Correlations between these groups of data were calculated.

The results indicate that social and inanimate stimulation, and contingent responding in each, are essential to the infant's development for different reasons. The authors conclude that social stimulation is directly related to social responsiveness and language development, and that inanimate stimulation is related to the development of exploratory behavior. Because of the distinctive merits of these two types of stimulation, they propose that examination of an infant's environment must then involve social, as well as nonsocial, aspects.

To conclude, the significance of contingency awareness for infant development is illustrated in the previous studies. Moreover, it is apparent that the caregiver-infant dyad, and particularly the features of interaction and contingent responsivity of the social environment, are instrumental in facilitating within the infant a sense of control over the surroundings. The research demonstrates the relationship of these elements of the social dyad to the child's cognitive and social development. It is evident (e.g., Simeonsson & Wiegerink, 1974; Yarrow et al., 1972) that the contingent transactions within the sphere of social interaction are extremely important and necessary to communication development.

Discussion

In light of the importance of contingency-learning experiences and the demonstrated capacity of young infants to detect these relationships, it is clear that a real danger exists for those children who do not develop such awareness. Many studies in the literature regarding contingency awareness for infants without handicaps (Finklestein & Ramey, 1977; Suomi, 1981; Watson, 1979) and for children with handicaps (Brinker, 1984; Brinker & Lewis, 1982a, 1982b; Robinson & Robinson, 1983; Smith, 1978; Utley, Duncan, Strain, & Scanlon, 1983) have included references to the theory of "learned helplessness" (Seligman, 1975). This theory proposes three potential outcomes for a subject who senses helplessness. First, if the child senses a lack of control over the immediate surroundings (i.e., events in that setting occur that are not related to the child's behavior) this perception can, over time, create the feeling that the child has no control in the environment. This feeling can lead to a lack of motivation to try to effect change in the environment. Second, based on this reduction in, or absence of, motivation to act on or control the environment the child's future perceptions of his/her control can be greatly impaired. In fact, this view can give way to a sense of helplessness; thus, impeding the ability to learn that responding to the environment can instigate change. Last, it is suggested that an end result of this learned helplessness may be emotional disturbance and depression.

Seligman suggests that the discovery of "synchrony" between one's responses and outcomes must happen if learned helplessness is to be avoided. Referencing Watson and Ramey (1972), Seligman (1975) discusses the importance of this discovery for the

child. He states that infants are constantly appraising their surroundings to identify some relationship between their own actions and the environment. What is considered pleasurable by them is not so much the stimulation (e.g., lights, bells), but the contingent relationship that they detect between their behavior and their world (i.e., the awareness that they can cause things to happen).

There is no consensus, however, as to the exact process of contingency perception in infancy (Suomi, 1981), and there is currently little longitudinal data to delineate the full effect of this awareness on cognitive and social development (Thurman, 1979). On the other hand, there is ample evidence to propose that a contingently responsive social and physical environment can have a significant, positive impact on the child's development. Brinker and Lewis (1982a) and Lewis, Sullivan, and Brooks-Gunn (1985) state that this type of environment facilitates the development of the child's cognition through the characteristics of motivation, attention, and affect. Moreover, they suggest that both social and physical co-occurrences are essential for developing this contingency awareness.

Seligman's learned-helplessness theory reinforces the position that the construction of a responsive surrounding is imperative if children are to learn that they can effectively act on their surroundings. Unfortunately, the child with deaf-blindness, because of reduced sensory capabilities and a limited response repertoire, may be relegated to a passive, noninteractive role in the world. All too often the dual sensory impairment precludes a variety of socially contingent experiences and restricts the menu of reinforcement options in the physical environment. Consequently, it is crucial that interventions be provided to ensure that opportunities are offered to facilitate the child's active participation in the world.

To date, a number of investigations that have been designed to look at contingency awareness have involved nonsocial contingencies (Suomi, 1981); for example, head movement by an infant that causes lights and music to go on. As efforts are directed to the development of communication skills with the target population it becomes important that avenues be explored that enhance not only the contingent interaction with the physical surroundings, but also the child's interactions with the social environment. For the individual with deaf-blindness the early contingency awareness in the social sphere, coupled with the development of a reliable means of social responding, are key components in building socially communicative skills.

It is clear that, under natural conditions, there is not a perfect contingent relationship in the social environment for some infant behavior and environmental outcomes (Brinker & Lewis, 1982a; Goldberg, 1977; Suomi, 1981; Watson, 1979). For instance, when the infant cries, the caregiver(s) may not respond in exactly the same amount of time or in precisely the same way each time, if at all. In contrast, in the inanimate world, a bell will always clang when shaken. For the child with deaf-blindness the lack of contingency within the social sphere is further complicated. As indicated in the chapter by Siegel-Causey, Ernst, and Guess these children may not display or may be delayed in demonstrating the social signals of vocalization, eyegaze, and smiling. In turn, the caregiver is confronted with signals that can be difficult to interpret, thus leading to fewer responses toward the child. Given this situation, it seems advantageous to explore the application of some alternative interventions in the social context. For example, a motor response by the child to activate a switch (typically regarded as a nonsocial response) results in social consequences. Though artificial, instrumentation, such as the microswitch and microcomputer technology, may be a powerful means for facilitating social interaction and communication. The feasibility and effectiveness of such a crossmatch (i.e., reinforcing a nonsocial response with social consequences) has been demonstrated (Millar, 1977). This subject is discussed in the following section.

Studies Involving Children With Severe Handicaps

In reviewing the literature on contingency awareness and its role in social and cognitive development, valuable information surfaces, relevant to the implementation of contingency-learning tasks with children who are severely handicapped. The focus of this section is to review studies that were designed to assess contingency awareness in infants and children with severe handicaps. The research that follows demonstrates that, not only is the development of contingency awareness essential to the child with severe handicaps, but that such learning is also feasible. Descriptions of this research include discussions of the various methodologies, microswitch and computer technology, utilized to ensure the accessibility of these contingency-learning opportunities.

Contingency-Awareness Studies

Among the earlier studies of contingency awareness involving an infant with severe handicaps is that described by Watson (1972). In this investigation an 8-month-old child was reported to be functioning at approximately 1.5 months in terms of development. The child had neither demonstrated any instrumental activity, nor any measurable attention to any person or object. On a daily basis, 10-minute intervention sessions with a contingent mobile were arranged. The target behavior was leg kicking to activate the mobile. Within 11 days, leg kicking increased from 3 to 12 times per minute. Additionally, the results indicated prolonged smiling and cooing during the contingent experience.

Haskett and Hollar (1978) conducted two studies with four youths (ages 9-17 years) with profound retardation, physical impairments, and mental ages below 7 months. All subjects' vision and hearing were found to be within the normal range of functioning. Each of the two studies involved two of the four students. In the first investigation visual stimuli were utilized. Phase One of this study compared the students' switch activations under response-dependent (the subject's response triggered the light's illumination) and no-illumination conditions. Phase Two was comprised of response-dependent conditions only. Phase Three was set up to examine the differences between lever-pressing responses in response-dependent and response-independent (the subject's behavior did not trigger the response) illumination arrangements. The second investigation used auditory stimuli and consisted of three parts that paralleled those phases in the first study. In each investigation, data were collected by observers as well as by recording equipment.

Results indicate that three of the four students demonstrated instrumental learning in activating microswitches to turn on lights or music. These same three students were also able to discriminate between response-dependent and response-independent stimulation. Further, observational data indicate that two of the students exhibited increased smiling in the presence of contingent auditory stimuli. The authors conclude that these subjects do "... possess a capacity to learn that cannot be much different from the capacity of less retarded subjects to condition and to discriminate contingencies" (p. 66). They also propose that the decreased incidence of exploratory behavior in the child with profound retardation may be due more to the lack of opportunity than to a deficit in motivation.

Zuromski, Smith, and Brown (1977) employed contingency awareness or "Active Stimulation" strategies with three infants with multiple handicaps (ages 1-2.5 years), one of whom was reported to be cortically deaf. The authors' purpose was to (a) demonstrate the feasibility of contingency experiences for children with severe handicaps and (b) demonstrate the usefulness of experiences as a means of bringing these children

into an interactive role with their physical environment. For one child, a mercury switch was attached to each of two objects, a ball and a toy. These objects were suspended over the child's playpen. When the child hit the correct object the action would cause switch closure and activate the reinforcer. This contingency would then be changed to the other object on the following day. For the two remaining children the mercury switches were attached directly to their right and left palms, movement of the correct hand would cause the closure of the switch, triggering inanimate consequence. The reinforcement was alternated regularly between right and left hand. In each instance selection and placement of the switches were dictated by the motor abilities of the child, and reinforcement was varied. For two of the children reinforcement consisted of taped recordings of their respective parents' voices; for the third child, music was employed. The frequency of occurrence of the targeted motor responses was collected by means of a data recorder that was activated by the switch closure.

The results indicate that each child's movements increased in response to the contingent stimulation. When a change was made requiring the infant to swat at the other object or to move the other hand to elicit the reinforcement, the subjects adjusted, thereby demonstrating some discrimination ability. The authors propose that this type of application of the microswitch technology may have particular relevance to those children with little opportunity to control environmental objects and events. It allows children with limited response repertoires to purposefully and directly act on their world. In turn, the physical world is made more responsive to even the most subtle behaviors of the child.

In a related study, Accrino and Zuromski (1978) reported similar success in discrimination tasks for two institutionalized children with profound retardation, who were 18 months of age and 5 years of age. In this study, a panel containing two switches was mounted in the crib of each child. A dowel was attached to each of the switches and, on one of these levers, a large plastic block was affixed. Baseline data were collected to indicate the frequency and the duration of each switch closure when no reinforcement was provided the subject. Reinforcement of either large- or small-lever activations were alternated across subjects and baseline conditions were reinstituted. Auditory reinforcement was used and changed daily to avoid habituation. Again, specific attention was paid to the design of the switching devices, requiring a response that was performed easily by each child.

In both cases the children demonstrated the ability to learn the targeted motor behavior. Specifically, the targeted motor behavior increased from baseline levels when reinforcement was made contingent upon its occurrence during conditioning. Moreover, the data indicate that each child was able to discriminate between reinforced and non-reinforced levers as well as displaying increased attention to these contingent stimuli. This was evidenced by the increase in behavior to activate the newly reinforced switch with a concurrent decrease in switch activations now to the non-reinforced manipulandum.

Brinker and Lewis (1982c) reported the results of studies with infants, ages 6 to 32 months. The first subject group consisted of four infants with moderate handicaps, and one infant with severe handicaps. The second group was comprised of four infants with profound retardation and multiple impairments, and one of these children had cortical blindness. None of the infants in either group had displayed any interest in looking at or manipulating objects prior to entering the study. After learning a specific response (e.g., vocalizing, headraising) to criterion (set at 25% above baseline) that would produce auditory, visual, or tactile consequences, the subjects were taught a second, individualized response. Subsequently, eight of the nine infants demonstrated

the ability to differentiate reinforced from nonreinforced responses; however, rate of learning differed among the infants.

The results clearly indicate that the subjects learned the criterion responses and were able to differentiate between the responses that were reinforced or not reinforced. The feasibility of altering the contingencies is enhanced by the microcomputer; thus, the authors suggest that additional analyses of the data via the computer could yield useful information regarding memory differences among these children. They further hypothesize that an investigation of rates of responding across sessions and contingencies may provide indication of "learning to learn." That is, as the children become increasingly aware of their control across these learning tasks, the rate with which they respond in new contingency situations should increase.

Hanson and Hanline (1985) conducted an investigation with three single subjects in which response-contingent experiences with electromechanical equipment were set up in each child's home. Following specific training regarding the intervention and data collections, each parent conducted the intervention with their child. The children, ranging in age from 8 to 25 months, exhibited moderate to severe developmental delays with sensory and motor impairments, and one child had a dual sensory handicap. For the first child, a kickpanel was attached to a vibrator. When the child contacted the panel with her leg, the resulting switch closure activated the vibration. For the second child, movement of his head to midline evoked visual and auditory reinforcement that was activated by the mother depressing a button. For the child with vision and hearing impairments, socially contingent reinforcement from the parent was delivered in response to a signalling device activated by the child's hand movement. All children showed increases in the targeted motor behaviors during treatment phases as compared to baseline. In addition, the study demonstrates the feasibility of providing such opportunities in the home by parents/caregivers.

Utley et al. (1983) conducted a study to investigate contingency awareness in four children ages 1.6 to 2.7 years. All of the subjects had multiple handicaps, were nonambulatory, and functioned at the profound level of retardation. In addition, one child was diagnosed as being cortically blind. Unlike the previously mentioned investigations that employed microswitch manipulation as the targeted response, the authors utilized visual fixation as the dependent variable. The reason for this was that none of the children had displayed any other voluntary, functional response. The authors believed that this response would be a reliable measure of the subjects' attention to stimuli. In the study, the duration of the subjects' visual fixation on a Christmas light display under alternating, noncontingent and contingent conditions was recorded by an observer.

The study was divided into three phases for each child. The first phase consisted of two 5-minute sessions daily; one session consisting of response-dependent illumination and the second consisting of response-independent illumination. The second phase was composed of two daily sessions that both consisted of illumination that was contingent upon visual fixation by the child. In the third and final phase, alternating treatment was reinstated. The results indicate that visual fixation, for each child, was greatest under contingent conditions. The children also demonstrated the ability to discriminate between the two conditions as is evidenced by a comparison of the mean duration of fixation in each arrangement for both the first and third phases. The authors state that this increase in visual fixation under response-contingent stimulation conditions may be an indicator of children's preference for contingent over noncontingent stimulation.

In a study conducted by Dunst, Cushing, and Vance (1985), a similar behavior (head turning together with visual fixation) to that used in the Utley et al. (1983) study was employed in a response-contingent learning task. The investigation involved six infants with profound handicaps and was designed to address the application of operant conditioning in the areas of assessment and intervention. Additionally, the study was arranged to compare the merits of different training methods. The head turn consisted of movement at least 60 degrees from the crib surface toward the child's midline with visual fixation on the display. This behavior was within the movement repertoire of each child, but was exhibited at only a low frequency. A light display was set above the infant who was in a supine position in the crib. Although this apparatus was present during baseline and extinction phases, the illumination of the display occurred only as consequence to the specified movement during the conditioning episodes.

For two of the students, fixated head turns were reinforced with illumination of the visual display during the conditioning phases for each. This phase consisted of 3 days for the first child and 2 days for the second. This demonstration of learning was shown by each child. This same response was then investigated for two more infants; however, the examiner sought to determine the possibility of yielding such a demonstration of learning within a single session. Lack of such an indication was attributed to insufficient time given the subjects for learning to occur. For the fifth child, a single-session training strategy was again employed; however, the length of the conditioning phase was extended from 5 to 10 minutes to approximately 30 minutes. In this instance, the subject did acquire the response-contingent behavior. The final part of the study investigated whether the use of graduated prompts might accelerate such conditioning. The amount of physical assistance provided the child to turn his head was gradually reduced during the intervention phase. In the final conditioning phase no prompting was used.

The data indicated an increase in visual fixation under these response-dependent conditions. Beyond the fact that four of the six infants did learn in the response-contingent task, the findings indicate that sufficient training time is necessary for this learning to occur. Furthermore, this time may be decreased through the use of prompting techniques. Such information is significant when considering similar procedures in assessing the learning capabilities of this population. Dunst et al. (1985) suggest that the demonstration of learning by these infants is valuable because of its positive social impact. That is, the parents' perception of their child as competent spawns new responsiveness on the part of the parent as well as the child.

Contingency Training

Robinson and Robinson (1983), in a chapter on sensorimotor functions and cognitive development, discuss the importance of arranging response-contingent experiences. Likewise, McCormick and Noonan (1984) propose that, "Only an environment which is arranged to elicit and reward active initiations can teach purposeful and independent behavior. An environment which does not attend to these behaviors will foster passivity and dependency" (p. 82). With frequent reference to the work of Brinker and Lewis (1982a) and Watson (1971), McCormick and Noonan suggest that this responsiveness to child initiated behaviors is crucial in both the social and physical environments. In line with this supposition, the following section provides a review of applications of the microswitch and microcomputer technology in the education of children with severe handicaps.

The Contingency Intervention Curriculum of Brinker and Lewis (1982c) provides a microcomputer-assisted program that is designed to give the infant a means of learning

to control the physical environment and, subsequently, to learn more elaborate and complex behaviors. The authors describe the curriculum as process, rather than content, oriented. Emphasis is on how the child attempts to solve problems, and not only on whether he or she actually does. This approach, then, requires assessment to be ongoing and integrated with intervention. Following the developmental order of Piaget, the curriculum begins at the primary circular reaction stage and progresses on through simple means-end behavior. In so doing, contingency awareness moves toward more elaborate levels. The microcomputer, with specially developed software, controls the contingent relationship between the child's movements and the consequences of the environment. For example, programming can require the child to perform different combinations of responses or new responses to elicit reinforcement. Along with the expanded capability of the microcomputer to alter reinforcement as well as movements to be reinforced, it can assist in the analysis of observational data recorded by an observer. This is accomplished through direct input of these observation codes to the computer. Further descriptions of computer functions in the contingency-intervention curriculum are provided by Brinker (1984).

Additional microcomputer-assisted, contingency-awareness programs have recently been developed such as the Contingency Software System of Contingency Software Inc. (1985). This software program covers the first five stages of sensorimotor development, and is designed along the principles of instrumental learning (i.e., developing opportunities for learning simple contingencies via a responsive environment). This system is designed to accommodate a wide variety of input switching devices and reinforcement options. In the two-diskette package, the first conducts the learning session, controlling for reinforcement ratio and duration, the number of switches used, and the specifics of the response (e.g., if two or more switches are used in a "sequential response task"). The second set of programs is for data analysis and displays.

The Active Stimulation Program (Zuromski, 1977) is designed to provide children a means of interacting actively in their physical environment. The program proposes that stimulation, contingent upon some behavior of the child, will be of more interest and more motivating to that child than other, noncontingent stimuli. The result of this experience is an increase in the reinforced motor behavior and an awareness within the child of the ability to bring about changes in the environment. Application of this approach in the areas of gross motor, fine motor, sensory motor, receptive language, expressive language, and cognition is provided in the Active Stimulation Programming (Zuromski, 1981). It is intended to augment intervention efforts for a given child, and provides descriptions of how to incorporate the technology for specific objectives (e.g., to increase head raising). The program includes specially designed manipulanda that provide a number of options for activation of different sensory stimuli. Control equipment allows for the regulation of reinforcement as well as providing a means of collecting data on the child's performance.

In Infant Learning: A Cognitive Linguistic Intervention Strategy, Dunst (1981) targets instructional approaches to be used with children with mental retardation and developmental disabilities. The model presented is neo-Piagetian, delineating Piaget's six stages of sensorimotor development in stimulus and response terms. The author proposes this model with a strong emphasis on the development of social and communication behaviors. Furthermore the interventions focus on functionality (i.e., the skills are warranted by and facilitated within the context of the child's natural environment).

Level One of the three-level model describes strategies intended to aid in the development of response-contingent behaviors in the social and communication domains as

well as the cognitive, as a point along the continuum toward cognitive-linguistic competence. Dunst argues that, to date, "many if not most infant curricula foster primarily knowledge of inanimate objects and in many instances actively discourage the development of psychosocial behaviors" (p. 3). Therefore this approach presents strategies for developing contingency awareness within the social as well as the nonsocial world. Many of the same behaviors are targeted as a means for the child to act on both the animate and inanimate environments (i.e., visual fixation on a turning mobile, or on an attending caregiver.) Dunst also describes microswitch application in these interventions among the techniques for causing various motor responses to elicit object activation. Vocalizations, eye gaze, and smiling comprise much of the infant response repertoire addressed within the social-contingency paradigm that is presented. The facilitation of social responsiveness underscores the necessity of the caregiver to be "both an initiator of and contingent responder to their infant's behavior" (p. 95).

Discussion and Implications

It may be concluded that the development of contingency awareness in a child is a crucial precursor to future learning. Stated otherwise, it is critical that an infant be able to detect the relationship between his or her behavior and the outcomes in the physical and social environment. This awareness of control motivates the child to respond in new ways as well as in new situations. It follows, then, that this type of interaction leads to an understanding of the relationship between the child's behavior and the environmental consequences. Unfortunately, for children with both vision and hearing impairments, there exists a very real risk for limited interaction and discovery of synchrony between their behaviors and the social and physical surroundings. The studies reviewed here could provide valuable assistance in efforts to develop a more responsive milieu. Furthermore, the microswitch and microcomputer technology have given educators a means to allow for such interaction in a systematic, consistent, and progressive continuum. This technology has ensured that children with such severe handicaps can employ even subtle and infrequent movements within their voluntary motor repertoire and temporal limits to act on their environment.

The vast majority of research cited in this chapter utilized sensory stimuli of the physical environment. It has been demonstrated that this inanimate stimulation is indeed effective as reinforcement for some children with profound handicaps (Guitierrez-Griep, 1984; Remington, Foxen, & Hogg, 1977; Sack & Wiseman, 1985; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985) and valuable in constructing such contingency-learning tasks. Additionally, the microcomputer can manipulate these stimuli to facilitate the learning experiences. To date, though, little of this existing research looks at the child with dual sensory impairments. Certainly, more investigations of this nature are needed.

It is also evident that social contingency experiences are crucial to development. The responses most often considered (i.e., eye gaze, smiling, vocalizations) may not be a viable option for the child with deaf-blindness, yet social stimuli as applied in similar response-contingent feedback paradigms have been shown to be effective in conditioning infant responding and providing opportunities for contingency intervention. Wacker and Mauer (1985), Hansen and Hanline (1985), and Schweigert (1986) demonstrated the feasibility of pairing motor responses that activated a microswitch manipulandum with social reinforcement for children with vision and hearing impairments. The literature on contingency awareness suggests that the fundamental concern is to provide opportunities to demonstrate this perception. Moreover, the writings make apparent the need for establishing a responsive environment (McCormick & Noonan, 1984) and multiple opportunities to experience systematic contingent feedback (Hanson & Hanline,

1985). Thus, it is clear that attempts to provide such learning experiences for the target population should not be precluded by the child's sensory impairments. Such efforts may require utilization of different interventions, such as the use of social reinforcement, to ensure these learning opportunities.

Next, and most essential for communication development, is whether or not contingency-intervention strategies and the related technology can provide a mechanism for enhancing development of social communication skills for the child with deaf-blindness. In the case of the child lacking motoric means of expression, the technology may provide a way for responding. Moreover, knowledge of the object world, such as that provided through contingent interaction, is an essential component for this development (Brinker & Lewis, 1982a; Fieber, 1978; Rogers-Warren & Warren, 1984). It is important that children be able to interact with and gain knowledge of their physical environment, as this provides them with a referent to share with another person (Rowland, this volume). However, as York, Nietupski, and Hamre-Nietupski (1985) caution, the use of the microswitch technology must not "be viewed as an end in and of itself" (p. 215). It should rather be considered a means to becoming more competent and independent. For communication this must include then becoming more socially interactive as well as more knowledgeable about the surroundings. Watson and Ramey (1972) similarly advised a parent providing her infant son multiple solitary sessions with object-contingency interactions that too much of this type of "entertainment" may preclude him from other opportunities to learn. These include those afforded within caregiver-child interactions. A child's interaction with and attention to the environment must not be limited to solitary situations. The increases in positive affective behaviors (i.e. smiling, cooing, vocalizing) during contingency learning have been reported frequently in the research (e.g., Brinker & Lewis, 1982c; Lewis et al., 1985; Watson, 1972). These have been viewed as indicators of learning, as well as preference for this type of stimulation. Yet they are social signals also, and have no influence on inanimate objects, only people (Hubley & Trevarthen, 1979). As such, attention to these emotional responses as communicative are important to social communication development and should not be ignored. Dunst and Lowe (1986) describe such facilitation of affective responses via nonsocial contingency experiences as one strategy for increasing social communication competencies. As Rogers-Warren and Warren (1984) propose, it is social attention and reinforcement of the child's interaction with his or her world that can provide a basis for future social interaction. Further investigation is indeed warranted to delineate such interventions and assess their impact on social communication development for the child with dual sensory impairments.

In a related vein, Light, Rothschild, Parnes (1986) utilized microswitch adaptation of objects in a study designed to investigate strategies for facilitating communication between a child with severe orthopedic handicaps and his mother. Although this modification of the toys did allow for more independence and control by the child, it also resulted in less imaginative play in interaction between the dyad members. Rather, the focus of the pair appeared to be more one of being "entertained" (p. 23). Certainly further study is necessary to investigate more fully the impact and implications of this technology and nonsocial contingency intervention on communication development for the target population.

Taken together, it is clear that contingency-learning tasks with the nonsocial world are insufficient in and of themselves to develop socially communicative competence, for they do not address social contingency experiences. They may in fact preclude interaction with people. As Yarrow et al. (1972) and Simeonsson and Wiegand (1974) propose, encounters with social contingencies are most important to communication development. Also suggested (Sexton, 1983; Golinkoff, 1983; Golinkoff, Harding, Carlson

& Sexton, 1984), is that the infant's understanding of his or her effect on and role within the inanimate and animate worlds differ. This position then further indicates the need to expand the focus of intervention efforts beyond the object world to include social/ or people/self-related contingency experiences. This broader approach to intervention has also been argued by Dunst (1981), and Dunst and Lowe (1986). As Fieber (1978) suggests, it is necessary to detect children's signals that are people oriented as well.

These signals may indeed be difficult to identify within the social response repertoire of the child with deaf-blindness. In fact, as Siegel-Causey et al. and Appell point out in this volume, the typically considered social behaviors of vocalization, eye gaze, and smiling may be delayed or absent. When a breakdown in social contingency interactions between the caregiver and child presents itself, it leads eventually to fewer opportunities for such exchanges and social learning experiences. In light of this, it is necessary to explore other avenues of social intervention. An example is the child who receives attention from another person dependent upon the child's switch activation. Continued exposure to this contingency opportunity contributes to the development of social contingency awareness. Moreover, the functional result of these experiences is that the child has developed the means to evoke attention, through some detectable behavior. Falvey (1986) has described this ability as "essential." Keogh and Reindle (1985) have stated that "... some sort of generalized signalling response allows severely handicapped children to exercise a measure of overt control over some aspects of their lives" (p. 166). It may be that such strategies utilizing social contingencies, paired with motor responses that are detectable and within the child's temporal and motor repertoire limits (as are made accessible through this technology), can provide a means for bringing these children into a more responsive, interactive, and communicative role with their social world.

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X. Augmentative Communication Systems

by

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Children with severe handicaps, such as deaf-blindness, are at special risk for developing normal symbolic communication. Stremel-Campbell and Matthews in an earlier chapter document that, as a rule, these children make very slow progress in developing skills for representational communication. Many children with deaf-blindness also exhibit other handicaps such as motor impairment and mental retardation. Because of the combination of deafness, blindness, and other accompanying handicaps, these children are at risk for developing functional oral speech, in addition to being slow to develop language (McDonald, 1980).

Alternative and augmentative communication systems (ACSS) can provide a means to communicate for many nonspeaking persons. Such systems have been demonstrated to provide persons with severe handicaps with options for an active communicative role (Allaire & Miller, 1983; Musselwhite & St. Louis, 1982). Moreover, some research (McDonald, 1980) has suggested that implementing ACSS (e.g., with sign language) may facilitate language development in persons with severe language handicaps.

The results of two demographic studies examining the communication modes used by school-aged children with deaf-blindness, have found that these children communicate primarily through nonspeech modes (see Table X-1) (Curtis & Donlon, 1984; Matas, Mathy-Laikko, Beukelman, & LeGresley, 1985). Because children with deaf-blindness are at risk for not speaking, and because available documentation indicates that they communicate primarily through nonspeech modes, research examining the efficacy of implementing ACSS with these types of young children is warranted. Specifically, it is important to examine how communication skills of these individuals can be enhanced through using ACSS.

The purpose of this review is to provide an overview of the use of ACSS with young children with deaf-blindness. The manuscript is divided into three parts. The first section provides a description of ACSS (features, classification, etc.). The second part of the chapter presents the issues in assessment and training of persons with severe handicaps to use ACSS. Finally, suggestions are made regarding research needs for implementing ACSS with persons manifesting severe handicaps and/or deaf-blindness.

Overview Of Augmentative Communicative Systems

Over the past decade, numerous ACSS have been developed or modified for persons with severe handicaps who are unable to use speech as their primary means of communication. These individuals may have neurophysiological limitations that impede speech development (e.g., dysarthria), sensory impairments that affect expressive and receptive language development (e.g., deafness and blindness), cognitive impairments that delay or preclude the attainment of representational behavior necessary for language development, or a combination of such impairments.

According to the American Speech-Language-Hearing Association position paper on "nonspeech" communication (1981), ACSS are classified as unaided or aided. Unaided nonspeech communication systems do not require any equipment or physical device. Such

Table X-1: Reports from demographic studies on communication systems used by children with deaf-blindness

System	N ^a	%	N ^b	%
Speech			6.4	19
Sign	2	10.5	7	21
Total communication			7	21
Gesture/emotion	5	26.3	6	18
Language boards				
Electronic systems				
Braille			1	3
None	11	57.9	1	3
Unknown			5	15
Total	19	100%	33.4	100%

Notes

^aFrom J. A. Matas, P. Mathy-Laikko, D. R. Beukelman, & K. LeGresley. (1985). Identifying the nonspeaking population: A demographic study. Augmentative and Alternative Communication, 1, 23-24.

^bFrom W. S. Curtis, & E. T. Donlon. (1984). A ten year follow-up study of deaf-blind children. Exceptional Children, 40, 452.

systems include sign language and gesture codes. In contrast to unaided systems, aided systems use separate hardware and/or software as a means to communicate. Aided systems are divided into two major types, electronic (microcomputers, voice synthesis, typewriters) and nonelectronic (communication boards, books, and charts). Figure X-1 provides an outline of augmentative communication aids and their associated parameters. In the rest of this section, different aspects of this classification system are described.

Unaided Augmentative Communicative Systems

A variety of gesture systems, sign languages, and codes comprise unaided nonspeech communication systems. This form of communication differs from speech in that the input and output medium is visual rather than auditory. There are two basic types of unaided systems: formal sign language and gestural codes. These systems vary according to the degree of cognitive/linguistic ability and motor skill required to use them successfully, as well as in the range of message complexity that can be expressed (Allaire & Miller, 1983).

Formal sign language. Formal sign languages offer the advantages of being portable, conceptually more simple (in some instances) in symbol to object/event correspondence, unrestricted in vocabulary, and similar to the fluid nature of spoken languages (Allaire & Miller, 1983). Several sign language systems have been developed to serve different populations in various contexts. For example, American Sign Language (ASL) is recognized as a unique language with its own syntactic, semantic, and pragmatic rules (Klima & Bellugi, 1979) and has historically been used as the primary mode of communication for the population of persons with deafness in the United States. ASL has also been used with other populations of individuals with handicaps, including persons with mental retardation and deafness (Reich, 1978), children with Down syndrome as young as 2 years of age (Wolf & McAlonie, 1977), and children with autism (Fulwiller & Fouts, 1976).

Other formal sign systems (e.g., Paget-Gorman Systematic Sign-PGSS, Signing Exact English-SEE2, Seeing Exact English-SEE1, Linguistics of Visual English-LVE or LOVE, Manual English, as described in Musselwhite & St. Louis, 1982) have been developed primarily for the school-aged child with deafness to facilitate the acquisition of oral and written English. These systems have been used to train linguistic skills as well as for communication systems; thus, they have been termed pedagogical systems (Allaire & Miller, 1983; Musselwhite & St. Louis, 1982). Pedagogical systems draw the majority of core signs from ASL. In addition, they include signs to represent English syntax and morphology, (e.g., signs for English morphemes such as -s, -ing, and -ed).

Gestural codes. A second group of unaided systems is composed of gestural codes. Included in this group are systems such as pantomime, Amer-Ind, and natural gestures. (See Musselwhite & St. Louis, 1982 for more information on gestural systems.) Amer-Ind was derived by Skelly (1979) from American Indian Sign Talk. It has no grammatical or structural rules, but instead uses demonstrative gestures such as pointing and descriptive gestures that imitate an object's movement or an outlined representation of an object. Skelly suggests that Amer-Ind may be a preferred gestural intervention strategy for persons with mental retardation because it is easy to learn with a minimum of formal training. Lloyd and Daniloff (1983) also suggest that Amer-Ind may be learned easily because it lacks the syntactic rule structure of formal signing systems.

Aided Augmentative Communicative Systems

Nonelectronic aids. Nonelectronic aids include simple communication boards, books, or cards. They most often display a set of pictures, words, letters, or other symbol

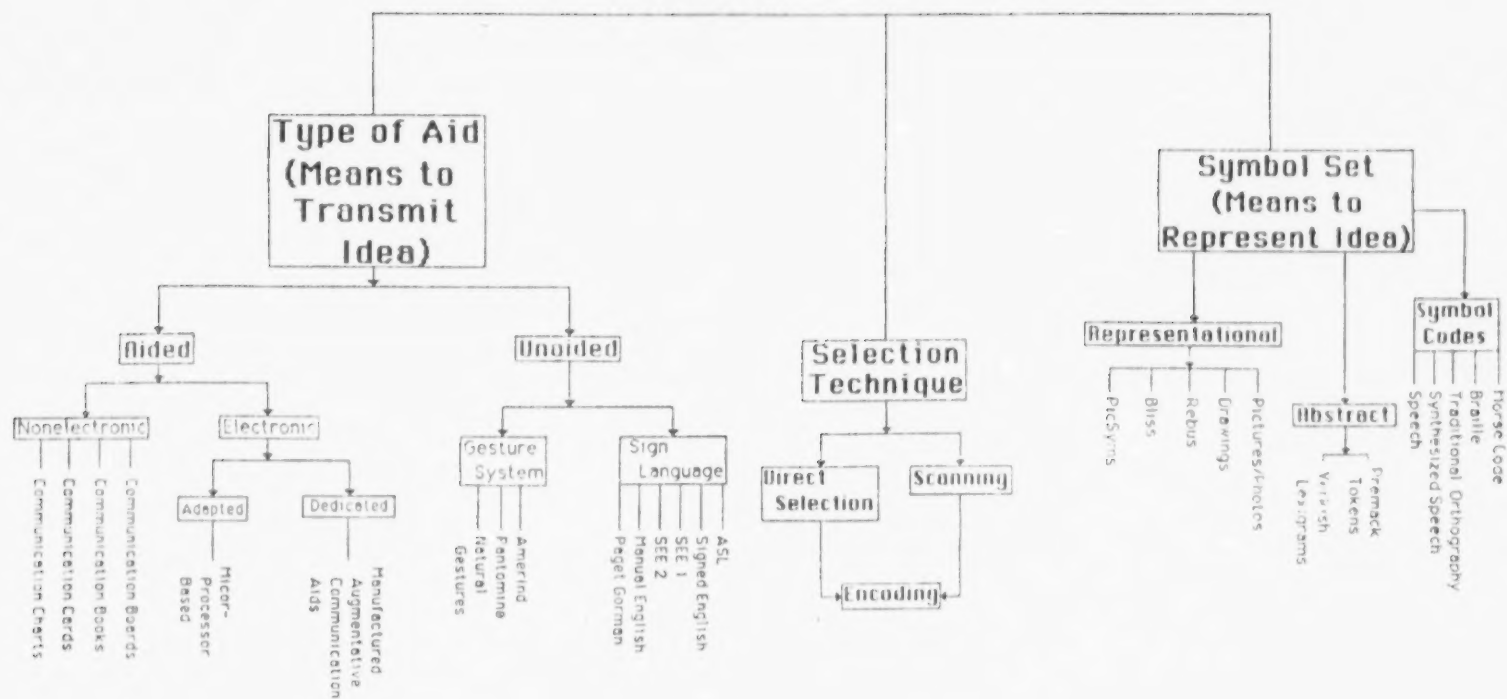


Figure X-1: Parameters in Augmentative Communication

sets that persons use in various ways to communicate (McDonald & Shultz, 1973; Musselwhite & St. Louis, 1982; Silverman, 1980; Vicker, 1974). Nonelectronic aids have several advantages: (a) they can be economically constructed; (b) they are adaptable to changing needs of individual users; and (c) they are flexible since they allow for use of a variety of symbols in varying formats (e.g., single picture, word, or symbol charts inserted under a plexiglass cover; small picture charts, word charts, symbol charts etc; conversation boards located in various rooms of the house, in the car and other usual environmental situations). A disadvantage of nonelectronic aids is that the output is visual and nonretrievable. Consequently, these systems require that the receiver carefully attend to the message as it is being constructed (Allaire & Miller, 1983). However, because they require the constant attention and participation of the listener nonelectronic aids are considered more sociable than electronic aids (Higginbotham, 1985).

Electronic aids. Electronic aids consist of four components: an accessing mechanism, a user display, control electronics, and an output mode (Beukelman, Yorkston, & Dowden, 1985; Silverman, 1980). Each of these components can be adapted to meet an individual's needs.

Switches can be used by the client to activate the aid. A large variety of switches are available that enable the person to use virtually any consistent physical ability or level of muscle strength. Some switches require pushing buttons, hitting a paddle or directing a light beam. Others can be operated using an eye gaze, vocalization, or electromyographic (EMG) control (see Musselwhite & St. Louis, 1982; Silverman, 1980; Vanderheiden & Grilley, 1976).

The user display consists of words, letters, phrases, pictures, or other symbols. In some aids the display is a keyboard; in other aids it is a panel of lights that indicate symbol locations. The display could also be a list of words, letters, or pictures on a board or booklet. Some aids use Morse code and, therefore, do not require a user display since the coding system is memorized by the user.

The third component, control electronics, is the mechanism for controlling the memory and programming capability of the aid. Some aids, such as a typewriter, simply transmit the message indicated to the output mode with no modification. Other aids provide means for retrieval of previously coded messages. Aids vary in their capacity for storing and retrieving messages or message components. Some aids have messages preprogrammed by the aid manufacturer while others allow the user to program his or her own messages (Beukelman et al., 1985).

The output mode of an electronic aid can be visual, auditory, written (printout), and/or combinations of these modes. Auditory output can be prerecorded, synthesized, or digitized speech. Bowe (1984) describes three main types of speech synthesizers used in electronic aids. The "phoneme coding" class of synthesizers store basic speech sounds and rules for stringing them together into words. The sounds and rules are stored within memory, therefore permitting a vocabulary that could be considered to be unlimited. An example of this type of synthesizer is the Votrax Type-'N-Talk (see Appendix X-B). A second type of speech synthesizer is called "linear predictive coding." This type of synthesizer stores an electronic model of the human vocal tract together with digital versions of pitch variability and range. To access the speech synthesizer, text-to-speech software programs are required, which contain language and production rules. An example of this type of synthesizer is the Echo II (see Appendix X-B). A third type of speech synthesizer uses "wave form digitization." This synthesizer is considered to produce the highest quality of output. An example of a "wave form digitization" speech synthesizer is the DecTalk (see Appendix X-B). Although now

available in a portable version, the cost of DecTalk is still too high to make it feasible for use in most portable ACSs.

Auditory output modes allow the flexibility to communicate over the phone and in situations where it is not possible for the communication partner to look at a visual output, such as while driving a car. Auditory output can also be used with listeners who cannot read. Moreover, because speech is the normal output mode for human communication, auditory output has been assumed to be more normalizing.

Visual output can have two forms, nonretrievable and hard copy (printed). With nonretrievable output, the user indicates (by pointing or other means) the symbols (words) that comprise his or her message while the communication partner watches. Visual, nonretrievable, media include a cathode ray tube (CRT) screen (e.g., TV monitor), liquid crystal display (LCD), or a light-emitting diode (LED) type panel for the indicated message. Aids with print capabilities provide "hardcopy" output in the form of normal sized print or raised dots as in Braille.

Electronic aids can be operated by persons with extreme motor limitations. Unfortunately, they are relatively costly, less portable, and more complex to operate and maintain than other augmentative aids. Further, they require a power source to run, and some require relying on a service center/manufacturer to assist with repairs.

Considerations With Aided Communication Systems

In fitting aided systems to a handicapped, nonspeaking person, two major considerations arise: determining the appropriate symbol system and determining the optimal message selection technique for the individual.

Symbol system selection. Musselwhite and St. Louis (1982) have delineated three levels of symbol systems. The first level, representational systems, includes symbols that have a close correspondence with the meanings they represent. Such symbol sets include miniature objects, pictures, photographs, drawings, as well as specially designed symbols such as Rebus (Clark & Woodcock, 1976), Blissymbols (Silverman, McNaughton, & Kates, 1978), Picsyms (Carlson, 1985), Pictogram Ideogram Communication (PIC) (Maharaj, 1980), and Picture Communication System (PCS) (Johnson, 1980). The second level, abstract symbols, consists of symbol sets that do not suggest the meanings they represent. Two examples of abstract symbol sets include lexigrams used in Yerkish (Rumbaugh, 1977) or Premack-type tokens (Premack & Premack, 1974). The Premack tokens are three dimensional and are designed to be used in the Non-Speech Language Initiation Program (NonSlip) (Carrier & Peak, 1975). A third level of symbols consists of symbolic codes. These are arbitrary codes that represent language such as traditional orthography, Braille, and Morse Code.

Representational systems, such as pictures and drawings, have been recommended for initial-aided ACSs because they can be used with young children who cannot read. Representational symbol sets have restricted syntax because some parts of speech are more difficult to effectively capture with pictures than others; thus there is an asymmetry in favor of nouns. The Yerkish tokens and Premack tokens are three dimensional so they can be discriminated by tactual manipulation which makes them a potential symbol set for persons with visual impairments. However, they are difficult to use as a communication system because of problems of display and portability.

Symbolic language codes require the highest level of cognitive functioning of the three levels of symbol systems. Variations of traditional orthography have been made

based on the phonemes of English that may be more salient for those with cognitive deficits (Musselwhite & St. Louis, 1982). An example of a modified orthographic system is the International Teaching Alphabet (i.t.a.). This alphabet has a one-to-one sound-symbol correspondence, and was developed to facilitate beginning reading (Musselwhite & St. Louis, 1982).

Besides the symbol set, one must choose the vocabulary for the ACS. Because some aids have a limited capacity for expansion, careful selection of vocabulary is important. Determining the vocabulary content of the ACS should also take into account the client's environment and potential interactants. For example, the vocabulary for an individual living in an institution may be different from someone living at home due to differences in communication needs or partners, for example. Client preference as well as the frequency of occurrence of words in the language are also considerations in vocabulary selection. In some commercially manufactured aids, the content is predetermined by the manufacturer. In other aids there are varying amounts of room for customizing the content.

Message selection techniques. Two major techniques can be used to select message elements. These are direct selection and scanning. Direct selection requires that the user directly indicate the message by pointing (e.g., with a finger, fist, head, eyes, light beam) (Allaire & Miller, 1983). When motor abilities do not preclude it, direct selection is the most normative, efficient, and rapid message selection technique (Musselwhite & St. Louis, 1982).

Scanning provides a way of indicating in both nonelectronic and electronic aided systems. In the nonelectronic mode the natural speaking interactant serially presents information to the user and waits for a prearranged response such as a nod, eye blink, or grunt. This technique places a heavy burden on the communication partner. Electronic scanning systems, on the other hand, involve a light or clock apparatus that moves systematically over the display at adjustable speeds. The user activates a switch to stop the scan when it reaches the message or message part he or she wants to indicate. Scanning can be used with persons who have severely limited motor skills; however, it is assumed to require higher cognitive functioning on the part of the user than direct selection (Musselwhite & St. Louis, 1982; Van Tatenhove, 1984).

A means of message selection that uses combinations of scanning and direct selection techniques is encoding (Vanderheiden, 1984). Encoding involves production of the message by using a predetermined code that is interpreted by the listener or translated to visual or auditory output by an electronic augmentative communication system. Morse code is an example of an encoding method that can be used with some electronic augmentative communication systems. The advantage of encoding is that it permits access to a large vocabulary in spite of limited motor abilities. The disadvantage is that it requires a multistep response that may not be appropriate for those individuals who have poor sequencing and memory skills as well as those who are severely motorically involved. The encoding process also demands more advanced cognitive skills than direct selection or scanning (Allaire & Miller, 1983).

For many clients a combination of message selection techniques and/or encoding approaches may provide optimum access to the communication system. For example, the client may start the day using a direct selection technique. As he or she becomes fatigued, a scanning technique or an encoding approach could be used that requires less physical effort. Alternatively, the client might use an encoding approach, incorporating direct selection to indicate the general area of the display and scanning to locate the specific message unit (Musselwhite & St. Louis, 1982). A more extensive discussion of

message selection techniques and encoding approaches is beyond the scope of this review. The interested reader should consult Vanderheiden (1984) for comprehensive coverage of this topic.

Issues in Implementing Augmentative Communication Systems with Children With Severe Handicaps and/or Deaf-Blindness

A list of the communication systems and approaches that have been used by persons with deaf-blindness is presented in Appendix X-A. Demographic research on the use of ACSs by individuals with severe handicaps and/or deaf-blindness (Aiello, 1980; Curtis & Donlon, 1984; Matas et al., 1985) indicates that sign language (and/or total communication approaches) and natural gestures and emotional reactions are the ACSs most frequently used with this population (see Table X-1). Further, among the children with deaf-blindness that were surveyed (Curtis & Donlon, 1983; Matas et al., 1985), from 3% to 57.9% were reported not to be using any communication system. Since most children with dual sensory impairments reportedly function with severe to profound mental retardation, it is not surprising that few were reported to use systems requiring a high degree of cognitive and linguistic ability (e.g., Braille, Morse Code). Moreover, since a majority of children with deaf-blindness function in the prelinguistic range of communication (Siegel-Causey, Ernst, & Guess, this volume; Stremel-Campbell & Matthews, this volume) it is also not surprising that many in the sample did not use any formal communication systems.

Clearly, these data suggest that there is much work to do in this area to improve communication programming for persons with deaf-blindness. Research to increase and improve the level of implementation of ACSs with persons with severe handicaps and/or deaf-blindness requires a thorough understanding of current issues in implementing ACSs. These issues, divided into the areas of assessment and training, are discussed in the following sections.

Assessment Issues

In the past 10 years, a number of books, papers and articles have focused on factors to consider in assessing clients for using ACSs (Chapman & Miller, 1980; Coleman, Cook, & Meyers, 1980; Kahn, 1975, 1983, 1984; McDonald, 1980; Musselwhite & St. Louis, 1982; Owens & House, 1984; Reichle & Karlan, 1985; Shane & Bashier, 1980; Silverman, 1980). A multilevel hierarchical decision-making process is required to ensure the consideration of all factors pertinent to recommending the most appropriate ACS (Owens & House, 1984; Shane, 1985; Shane & Bashier, 1980). The most frequently used approach to ACS assessment has been conceptualized as a two-level decision-making process (Owens & House, 1984; Shane & Bashier, 1980). The first level involves determining whether to "elect" to implement an ACS, "reject" implementation (because speech is adequate), or "delay" implementation until prerequisite skills have been developed (Chapman & Miller, 1980; Owens & House, 1984; Shane & Bashier, 1980). If the decision is made to elect or delay, then a second level of assessment begins. If an elect decision is made, the most appropriate ACS and training approach must be determined, based on client needs and abilities. A delay decision requires selecting the most efficient training approach to develop readiness for using an ACS.

Another perspective on decision making for selecting and implementing augmentative communication systems has been proposed by Reichle and Karlan (1985). They reviewed the literature addressing decision rules for augmentative communication systems and concluded that all of the present decision-making strategies are based on determining that a certain number of cognitive prerequisites are met before an aid

should be considered. They argue, however, that there is no empirical evidence that directly links certain cognitive skills to language learning in children who are either normally developing or those with intellectual impairments. Therefore, they advocate that training in functional communication skills using augmentative communication skills should not be delayed because certain cognitive prerequisites do not appear to have been met. Instead, they suggest that training in functional communication and training in cognitive skills can be accomplished simultaneously.

Regardless of the perspective on decision making, assessment for an augmentative communication system requires evaluation of many factors pertaining to the client, his or her environment, and his or her interaction within the environment. Each of these areas is considered in the following sections.

Client factors. Because of the myriad of data necessary, the assessment for an ACS usually is conducted by a multidisciplinary assessment team (Montgomery, 1980). For persons with severe sensory impairments, the following factors are considered in an ACS assessment: cognitive level; oral reflexes, and speech and language level; visual, auditory and tactile/tactual perception; and motor development/ability.

Regarding cognitive assessment, sensory motor Stage VI functioning has been considered by some investigators to be a prerequisite for electing to implement an ACS (Chapman & Miller, 1980; Owens & House, 1984; Shane & Bashier, 1980). Moreover, Bryen & Joyce (1985) reviewed 43 communication studies on persons with severe/profound retardation and autism and concluded that among the factors that lead to successful outcomes was the tendency to take into account cognitive level in subject selection.

Valid cognitive assessment is problematic, however, with children with sensory impairments (Rowland, this volume). Information from observational assessments and parent reports may assist in determining the child's level of cognitive functioning. Adaptation of ordinal scales of cognitive development (e.g., Uzgiris & Hunt, 1975) have also been recommended (Dunst, 1981; Kahn, 1984; Owens & House, 1984).

Oral reflexes, motor speech, and language are also important factors in the ACS assessment. Persistence of primitive oral reflexes places an individual in the "high risk" category for being nonspeaking (Shane & Bashier, 1980). Musselwhite and St. Louis (1982) and McDonald (1980) suggest that persistence of oral reflexes should automatically alert the multidisciplinary team to begin planning for ACS programming.

Receptive language skills may also affect the decision to delay or elect to implement an ACS. Although exact guidelines are not yet established, ability to discriminate object and action labels and to follow one-stage commands have been recommended as prerequisites to implementing an ACS (Owens & House, 1984).

Minimal success in previous speech therapy using an "oral-only" approach is another factor that has been considered in deciding to implement an ACS (Musselwhite & St. Louis, 1982; Owens & House, 1984; Shane & Bashier, 1980). This factor is considered to be pertinent only if the individual is not otherwise at risk for being nonspeaking due to severe physical, affective, or cognitive limitations (Owens & House, 1984). For individuals in the high-risk group, speech therapy and ACS programming should be implemented simultaneously, with communication (regardless of the mode) being the primary goal.

Once the decision to implement an ACS has been made, visual, auditory, and tactile/tactual perception and motor assessments are needed to determine the mode(s) of

input and output in communication programming. This information is also needed to determine the most appropriate ACS (e.g., aided or unaided). For individuals with deaf-blindness the tactual mode is an obvious alternative input and output mode. However, reliable tools to assess tactile/tactual capabilities in children with deaf-blindness are limited (Hart & Spellman, this volume). If objects, three-dimensional shapes, and/or textured surfaces are being considered as part of the ACS, informal assessment of functional use of objects, shape sorting, and texture discrimination should be conducted. Play assessments involving objects could be used to gather this information (see Fewell, 1983; Chapter VII, this volume). Observation of play, can also provide information regarding cognitive level (representational thought) (Fewell, 1983; Piaget, 1962).

Reliable visual and auditory acuity and perceptual assessments are difficult to obtain from individuals with deaf-blindness (Cress, this volume; Brandt & Spradlin, this volume). Information obtained from observing the individual's functional use of these senses should be used to substantiate formal assessment. Visual and auditory assessment is needed for decisions about the type of input for communication training. Presence of functional residual hearing and/or visual abilities can also widen the field of choices for the type of ACS to implement. For example, Hicks (1979) explored the relationship of visual impairments (retinitis pigmentosa) and the perception of ASL. She found that certain alterations of factors such as distance, magnitude, and duration of signs made them more perceptible to her subjects. Further studies are needed to determine the effects of altering the perceptual characteristics of signs and pictorial systems (e.g., Bliss, Piesyms) on their perceptability by visually impaired persons.

The goal of motor assessment in ACS programming is to determine the most reliable movements for accessing an ACS (Musselwhite & St. Louis, 1982; Silverman, 1980). ACSs vary in their motor requirements. Sign languages, for example, require good manual dexterity. Topper-Zweiban (1977) found performance on the Manual Expression subtests of the Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, & Kirk, 1968) was the best indicator in predicting the successful training of sign language. If the decision is made to implement an aided ACS, motor assessment is needed to determine if direct selection can be used or if some other means to indicate (scanning, encoding) will be necessary.

Environmental factors. Successful implementation of an ACS, or any communication programming, requires commitment from the persons in the child's environment. Therefore, an integral part of the decision to implement an ACS depends on ensuring the cooperation and active participation of parents, teachers, institutional staff, and other potential communication partners (Owens & House, 1984). Often, parents are reluctant to accept the decision to implement an ACS because they think it means giving up the hope of achieving normal speech. The clinician can reassure parents by pointing out that research to date indicates implementing an ACS does not impede speech development but, instead, appears to enhance it (Moore, 1980; Musselwhite & St. Louis, 1982; Silverman, 1980). In the case of an aided system, another environmental factor to consider is whether the ACS will interfere with activities of daily living.

Environmental interaction factors. Communication assessment of an individual with severe handicaps is not complete without an analysis of his or her interactions within the environment (Mirenda, 1985; Owens & House, 1984; Reichle & Yoder, 1979; Yoder & Villarruel, 1985). In addition to providing validation of formal assessment procedures, environmental observational assessments can provide information to assist in designing the ACS and training approach. For example, by observing the individual in daily life situations, one can determine the individual's current means of communicating needs and wants. This information can be used to determine an initial vocabulary for

the ACS. A number of authors have suggested environmental observation strategies that can be used for ACS vocabulary planning (Brown et al., 1980; Carlson, 1981; Musselwhite & St. Louis, 1982; Yoder, 1980).

Data on caregiver responsiveness to child behaviors and early communicative intents can also be gathered during environmental observations. Successful early communication training often begins by training the caregiver to notice and consistently respond to child behaviors as if they were communicative (Chapman & Miller, 1980; Reichle & Yoder, 1979). Pragmatic protocols for assessing early communicative intents of persons with severe handicaps are just beginning to be developed (Cirrin & Rowland, 1985). Continued research is needed in the area of observational assessment of early intentional behaviors in this population.

Conclusion. The goal of assessment for an ACS is to collect and integrate information about the nonspeaking individual, his or her environment, and how the individual interacts within the environment. This procedure includes evaluating the individual's cognitive functioning, sensory status, and level of communication, as well as observing how the child's caregivers and others in the environment respond to his or her communicative attempts. Thorough assessment of these areas is needed to decide (a) whether to elect or reject implementation of an ACS, (b) the type of ACS to implement, and (c) the type of skill training approach to use. As indicated in this section, continued research is needed to develop assessment tools and approaches for assessing cognitive, linguistic and sensory functioning as well as strategies for observing how persons in the environment interact with and respond to children with severe handicaps and/or deaf-blindness. Such tools and techniques are needed in order to obtain a greater understanding of these individuals' skills and abilities that can then lead to the development of the most appropriate ACSs and training approaches for them.

Training Issues

To date, most of the information on implementing communication systems with persons with deaf-blindness has focused on the description of ACSs. In order to make decisions regarding the most appropriate ACS and training techniques for these individuals, more research is needed comparing ACS types, message selection techniques, and symbol sets (Kiernan, 1981). For instance, is one system or approach easier to learn than another for persons with particular sensory, cognitive, and/or linguistic abilities?

The following section addresses training issues and is divided into two parts. The first part considers issues in training prerequisite skills and initial use of ACSs. The second discusses the research in the implementation and use of an ACS. Throughout the training section relevant literature is reviewed, pertinent theoretical and methodological questions are asked, and directions for future research are proposed.

Training prerequisite skills for using an ACS. Because a majority of young children with deaf-blindness function at the prerepresentational and prelinguistic level, research in determining the most efficacious strategies for facilitating communicative development and initial use of an ACS is badly needed. Three primary goals of early communication training exist for the child:

1. To learn to separate self from the environment
2. To understand that his or her actions can affect the environment (communicate)

3. To learn that there are things to communicate about and people to communicate with.

Consideration of how best to accomplish these goals has raised many questions among researchers and clinicians. Can and should we attempt to train objective skills such as object permanence and means-end? Will direct training of such skills lead to increased success in communication programming? What is the best environment for fostering growth in the communication of individuals with severe handicaps? Can and should computer technology be used to train cognitive skills and communicative behaviors?

The value of direct training of cognitive skills has been questioned from two perspectives. Chapman and Miller (1980) and Miller and Chapman (1984) have argued that attempts to directly accelerate cognitive growth have produced equivocal results. Therefore, following a developmental perspective, Miller and Chapman advocate that enrichment rather than acceleration should be the goal of programming during the sensory motor period. Functionalists, on the other hand, claim that focus on prerequisites is a barrier to education of severely handicapped persons. Because a child has handicaps/sensory impairments, the normal developmental milestones may not be appropriate as these children may exhibit a wider age range of behaviors than normal, depending on motor skills and the gap between chronological and mental age. Functionalists advocate the use of behavioral technology to train chronological-age-appropriate communicative skills whenever possible (Brown, et al., 1980).

The above controversy notwithstanding, Kahn (1978, 1984) demonstrated that cognitive training accelerated the development of object permanence, means-end, and consequent language development of children with profound mental retardation. Using a between-groups design, Kahn (1984) compared three language training conditions with three groups of children with profound mental retardation whose chronological ages ranged from 3 to 10 years. Prior to training, the groups were matched on a sensory motor assessment (Uzgiris & Hunt, 1975), a developmental assessment and a probe of prelinguistic development (Bricker, Dennison, & Bricker, 1976). One group received language training alone and the other two groups received the same language training program preceded by instruction in either object permanence or means-end. Before proceeding to language training, the two cognitive groups received cognitive training until they met the criteria of successful performance on the highest item on the means-end or on the object permanence scales (Uzgiris & Hunt, 1975). Kahn found that the groups that received language training following training in either object permanence or means-end, made significant gains in subsequent language treatment, but the group that received only language training remained at a prelinguistic level. Kahn's findings provide validation for the relationship between cognition and language development. However, it remains unclear whether direct cognitive training is the most efficient means to foster communicative growth. Still at issue is the question of determining the best environment for facilitating early communication skills with severely handicapped individuals.

Research in normal parent-child interaction indicates that communication develops in a socially responsive environment. In a detailed review of the role of parent-child interaction during the second year of life, Chapman (1981) concluded that parent input has a demonstrable effect on language development when it is contingent upon child-initiated actions and utterances. She concluded that the most important operating principle for the caregiver during this period is to "Pay attention to what the child is doing and saying" (p. 294).

Because children with severe handicaps and sensory impairments are less active and responsive to their environment than normal children, the parent-child interaction process becomes asymmetrical (Siegel-Causey, Ernst, & Guess, this volume). When parents do not receive expected feedback from their child, they, in turn, may become less motivated to engage the child in interactive exchanges.

A number of researchers have begun to explore means of creating a socially responsive environment for the communication development of individuals with severe handicaps and sensory impairments (Dunst, 1981; Reichle & Yoder, 1979, Rogow, 1982, 1984; Sternberg, Battle, & Hill 1981). These investigations are beginning to demonstrate that caregivers can be trained to provide an enriched socially responsive environment. Further, these interventions have led to increases in communicative behaviors in persons with severe handicapping conditions.

Another approach to training early communication behavior has been the implementation of computer technology. Specifically, the use of computer technology and battery-operated toys is being explored as a way to foster cognitive and communicative development (Bambara, Siegel-McGill, Shores, & Fox, 1984; Brinker & Lewis, 1982a, 1982b; Meyers, 1984; Mills & Higgins, 1984). For example, Brinker and Lewis (1982a) used an Apple IIe computer to examine the effect of providing contingent and noncontingent responses to three infants with handicaps. The infants' ages ranged from 3 to 6 months. The subjects learned to pull a string to elicit a contingent consequence and they remained more alert and less fussy during contingent stimulation than during noncontingent stimulation. Results indicated that response-contingent stimulation caused the infants to increase active control over their environments.

Meyers (1984) presented single-case study results demonstrating the use of microcomputers to teach early communication behaviors. In one case, the Apple IIe computer was interfaced with a 12- by 21-inch keyboard and a speech synthesizer to teach early requesting behaviors to a 26-month-old boy with blindness and other severe handicaps. Environmental assessment had determined that the child seemed to show definite signs of pleasure when his parents sang to him. Therefore, the membrane keyboard was programmed so that anytime the child touched it the speech synthesizer generated the word "sing." Then, through a carefully scaffolded training approach, the child was taught to intentionally place his hand on the keyboard to request his mother to sing to him. Although this type of inquiry is in its infancy it holds promise for early communication training for ACS use. Rather than focusing on development of prerequisite skills, Meyers (1984) provides a device that allows the child to control a communication partner within the social interaction framework. In this way the connection between switch activation (ACS use) and communication is fostered without waiting for representational skills to develop.

Training to use augmentative communication systems. Harris and Vanderheiden (1980), Kraat (1986), Musselwhite and St. Louis (1982), and Yoder and Kraat (1983) identified three uses of ACSs. First, ACSs have been used to supplement vocal communication for persons with marginally intelligible speech. Second, for persons with no functional speech, ACSs have been used as a primary communication mode. Finally, for individuals with severe language impairments, ACSs have been implemented to facilitate the development of communication skills (Moores, 1980).

Because aided and unaided ACS's allow for the manipulation of input features such as perceptual salience (visual, tactual), duration and abstractness (relationship of symbol of referent), as well as the ability to shape output more directly than in verbal language training, it has been suggested that such systems may simplify the task of

language learning for persons with severe language impairments (Moore, 1980). Support for this hypothesis has been provided by studies that demonstrate that training these persons to use ACSs can lead to development/increase in communication and language skills. (For more complete reviews see Kiernan, 1979 and Ronski, Sevcik, & Joyner, 1984.)

After reviewing the results of studies in which persons with mental retardation were trained to use unaided systems to facilitate communication skills, Kiernan (1979) posed an alternative hypothesis to that of Moore (1980):

It may be that some at least of the subjects who have learned to use manual communication would have learned to speak had the conditions of learning been optimized. It is a common observation that in signing the normal user reduces sentence length, restricts vocabulary and ensures that the listener is looking. These factors in themselves could lead to rapid acquisition of communication. (p. 92)

Kiernan further argued that studies are needed that directly compare the effects of communication training across expressive modes (aided, unaided, speech). In addition, he called for comparisons of the factors affecting ease of acquisition within the broad categories of aided and unaided systems.

A few studies have compared the effects of communication training with unaided ACSs to speech training with children with mental retardation (Kahn, 1977, 1981) and with autism (Brady & Smouse, 1978). Kahn (1977, 1981) failed to demonstrate significant differences between speech training alone and speech training with sign training after 9 months (Kahn, 1977) or after 3 years (Kahn, 1981) of treatment. Subjects were matched on age, sex, and etiology. Both the speech and sign training groups, however, made greater gains than the group that received no direct language intervention. Using a single-subject, simultaneous-treatment design, Brady and Smouse (1978) compared the effects of speech alone, sign alone, and Total Communication (sign plus speech) methods to train an experimental language with a 7-year-old boy with autism and who did not speak. Their results indicated that Total Communication was the most successful teaching approach followed by sign alone and speech alone respectively.

Further study that compares speech to ACS training is needed to answer the question of ACS facilitation of language development. To date, studies have only compared unaided (manual systems) to speech training. In addition, these studies have focused on gains in expressive language skills. Future studies should also examine subject gains in language comprehension across training methods. There is also a need for more careful control of subject characteristics (e.g., cognitive level, physical abilities) in future studies (Kiernan, 1979). Finally, it is apparent that answers to the following questions are needed to plan ACS communication training programs for persons with deaf-blindness and other severely handicapped individuals:

- Is ACS training (using aided and/or unaided systems) a more effective method for training communication skills than verbal language training in populations with severe language impairments?
- Holding physical and sensory factors constant, which ACS (aided versus unaided) is easier to learn by persons with severe language impairments?
- Within aided and within unaided systems, what are the most important factors to consider in selecting a first vocabulary?

- How do physical and sensory impairments affect the decision regarding which type of ACS to implement?

Once the decision has been made, to implement an ACS to facilitate communication development, the particular ACS approach (aided, unaided, or combination) must be selected. Historically, motor and environmental factors have predominated in dictating the decision to implement an aided or an unaided system (Owens & House, 1984; Shane, 1980). Sign language requires a greater degree of manual dexterity than is required by aided systems and therefore aided systems are usually recommended for persons with severe physical impairments. The primary environmental consideration is whether the other persons in the user's environment will understand the system. Aided systems can be used with pictures, symbols, and/or auditory output, and therefore may be used with a wider variety of potential partners. Sign language systems, however, are limited to partners who know sign techniques.

Cognitive demands of aided versus unaided systems may also determine system selection. For example, comparison of evidence from children with deafness and normal hearing of parents with deafness, with children of parents with normal hearing indicates that first signs are acquired earlier than first words (Schlesinger, 1978; Schlesinger & Meadow, 1972). Although these results require replication in more controlled studies, they suggest that the cognitive prerequisites for sign language may be less demanding than for speech (c.f. Kahn 1977, 1981). But, how do the cognitive requirements of aided systems and unaided systems compare? To answer this question, a beginning step is to determine which ACS approach (aided or unaided) is easier to learn.

To address cognitive (representational) demands, comparisons of aided and unaided systems on the basis of ease of vocabulary acquisition provide a logical starting place. Two studies have compared ease of learning of an unaided symbol system (ASL) with an aided symbol system (Blissymbols). Using a between-groups design, Sears and Sears (1982) compared the number of ASL signs and Blissymbols learned after 2 months of daily training (20 minutes per day) across two groups of school-aged children with profound retardation ($n=3$ in each group). Prior to training, none of the subjects used any intelligible verbalization nor did they have any known sensory or motor impairments. The average number of Blissymbols acquired was 17 and the average number of signs was 4.3. Most of this difference, however, was due to one subject who learned three times as many Blissymbols as the other two subjects in the group. This subject was also reported to be the most attentive during training. Another weakness of this study was that no rationale was given for selecting the signs and/or symbols to be taught. Therefore, intersystem factors, such as ease of learning, iconicity (the degree to which the sign or symbol represents its referent), and motivation, could have confounded the results.

In a larger, more controlled study, Bristow and Fristoe (1984) compared the learning of Blissymbols and Signed English in twenty 7- to 8-year-old children without handicaps. To control for the effects of prior knowledge, signs and symbols with a low translucency rating were selected for the study. (Translucency was defined as the closeness of the relationship between the physical appearance of the sign or symbol and its meaning.) Using a stimulus equivalency design involving three phases, 12 signs and 12 Blissymbols were taught. In Phase 1, subjects learned to pair familiar objects with nonsense words. In Phase 2, the subjects learned the signs or symbols for the objects. In Phase 3, subjects were assessed on their ability to produce the correct sign or symbol when the spoken nonsense word was given. Phases 1 and 2 were implemented during one training session. The children received training on 12 signs and 12 symbols until the criterion of 100% accuracy was reached. Training was followed by two posttests

(Phase 3), one after criterion had been met, and one approximately 24 hours later. Analysis of variance results revealed no main effect for symbol system at either posttest interval. Further, while mean trials to criterion were greater for Blissymbols (4.05) than for signs (3.95), the difference was not statistically significant. In discussing their results, Bristow and Fristoe noted that, while group differences were not significant, individual differences were noted in every phase of the study suggesting that "some individuals may find one system easier to acquire than another" (p. 150). Therefore, it was suggested that when other factors (motor) are equal, teaching probes may be useful in selection of the best system (aided, unaided, or combination) for an individual client.

In contrast to intersystem comparisons, greater attention has been paid to intrasystem factors. The bulk of the research has focused on examining factors that lead to ease of learning the three levels of symbolic systems and/or sign language systems. Learning factors that have been examined for aided and unaided systems will be discussed in the following paragraphs.

Unaided Systems. The most attention has been given to the feature of iconicity and its relationship to sign acquisition in populations with severe language impairments. "In psycholinguistic terms, iconicity refers to any association between a sign and its referent" (Page, 1985, p. 241). Iconic signs have been further divided into two groups, transparent and translucent. Transparent signs bear a close structural relationship to their referents so that persons unfamiliar with the sign may easily guess its referent. Translucent signs have a metonymic relationship to their referents; thus, they are not as easily guessable as transparent signs. However, when persons unfamiliar with signs are presented with the sign and its referent, they are easily able to determine a relationship between the two. Transparency has been operationally defined as the "guessability" of the referent when presented with the sign. Conversely, translucency has been operationally defined as agreement about the presence of iconicity, using an interval rating scale (Page, 1985).

A number of studies have found that iconic signs are acquired faster than non-iconic signs by persons with mental retardation and severe language impairments (Griffith & Robinson, 1980, 1981; Luftig, 1983). Therefore, it has been recommended that iconicity be considered when developing a first lexicon (Luftig, 1983).

Griffith, Robinson, and Panagos (1983) and Griffith and Robinson (1984) compared ratings of visual iconicity (translucency) with ratings of tactile iconicity by adults with blindness. The findings of both studies indicated that signs that had been rated as being iconic by visual inspection, also received the highest ratings of tactile iconicity. From these results, Griffith and Robinson (1984) provided a list of the most highly iconic signs from which to choose a first teaching vocabulary for children with deaf-blindness. Most of these signs were also included in the first lexicon suggested by Fristoe and Lloyd (1980), which was based on normal language development. Griffith and Robinson (1984) hypothesized that the role of iconicity may be its value in organizing early language learning. Iconic signs usually represent more concrete concepts and may therefore provide the initial successes needed to learn later (more abstract) language skills.

Taken together, these results suggest that iconicity may interact with other factors (e.g., functionality, ease of formation) in determining the ease of learning an initial signing lexicon. Further study of populations with severe language impairments is needed to clarify the role of factors such as iconicity and functionality, as well as teaching method for early learning of sign language (Doherty, 1985).

Aided systems. If the decision has been made to implement an aided system, the next decision is to determine which symbol system is easiest to acquire. The categories of symbol systems that have been used with aided systems (representational, abstract, and symbolic) were described earlier in this paper.

Mizuko (1985) reviewed the studies on aided symbol system learning. Based on this review, Mizuko concluded that the limited evidence available to date suggests that Blissymbolics is easier to learn than traditional orthography and that Rebus and Pictogram Ideogram Communication (PIC) are easier to learn than Blissymbolics. But, Mizuko found no studies that directly compared ease of learning across systems within the representational symbol set category such as Picture Communication System (PCS) (Johnson, 1980), PIC (Maharaj, 1980), Picsyms (Carlson, 1985), Rebus (Clark & Woodcock, 1976) and Blissymbols (Silverman, McNaughton, & Kates, 1978). Mizuko argued that, when determining the most appropriate early representational symbol system for early ACS intervention with learners with severe language impairments, a first step is to find out which system is easiest to learn by young normal children.

Using a factorial design, Mizuko (1985) examined the relationship of iconicity to ease of learning by 3-year-old children within and across three representational systems (PCS, Picsyms, and Blissymbolics). Across systems, he examined which system is the most learnable and iconic (transparent). Within systems, differences in iconicity and ease of learning across word classes (nouns, verbs, and determiners) were investigated. The overall findings indicated that PCS was the easiest system to learn, followed by Picsyms and Blissymbolics, respectively. Differences in ease of learning across word classes were also found. Overall, nouns were easiest to learn, followed by verbs and descriptors. Finally, Mizuko found that rankings of the symbols on iconicity were significantly correlated to rankings of ease of learning.

The results of studies that have compared aided symbol systems suggest that some systems may be easier to learn than others. This information should be taken into account when selecting first symbol lexicons for aided systems. Mirenda (1985) has cautioned, however, that regardless of the results of group studies, individual learner characteristics and preferences should also be considered in selecting representational symbol systems. Some authors have suggested selecting symbols from across and within symbol categories based on learner probes (Beukelman et al., 1985; Mirenda, 1985; Shane, 1981).

Research is needed to examine symbol learning in populations with severe language impairments. No studies, for example, have compared the ease of learning of symbol systems by persons with visual impairments. For individuals with deaf-blindness, whose physical impairments may preclude the use of signing, research is needed to examine the ease of learning of visual, tactile, and three-dimensional abstract symbols (e.g., Non-Slip).

Another aspect of aided systems that may affect ease of learning is the message selection technique and switch interfaces of an ACS. As was described earlier, a hierarchy of message selection techniques has been proposed, beginning with direct selection as the simplest approach followed by scanning techniques and combination approaches, such as encoding. Therefore, direct selection would be the mode of choice if the child has the physical abilities to use it. Due to physical limitations, however, direct selection may not be an option for some individuals who cannot speak.

Except for examining physical capabilities, there has been little empirical study of the factors that may affect an individual's ability to use various switch interfaces

and/or means to indicate on an ACS. A number of authors have suggested that achievement of Piaget's sensory motor Stage VI is a prerequisite for ACS training. Although this suggestion has been tied primarily to the cognitive hypothesis for language development, Van Tatenhove (1984) has indicated that cognitive level may dictate message selection techniques as well. Further research is needed to elucidate the relationships between factors, such as cognitive level, linguistic development, physical capabilities, and use of various message selection techniques and switch interfaces in the application of ACSs with young children with deaf-blindness. Based on information processing theory, relationships between these factors would be predicted. For example, because different processing demands are involved, it may be easier for the child to learn to use a switch to cause a toy to move than it is to use the same switch to operate the toy by stopping a scanner on an ACS to request a toy. Research with children without handicaps may be a first step toward developing a better understanding of how cognitive and linguistic factors affect ability to use an ACS when message selection techniques and switch interfaces are systematically varied.

Summary and Conclusions

There are many issues that affect assessing and training persons with severe handicaps and/or deaf-blindness to use ACSs. In this review we have indicated that the primary areas include the following:

- Features of ACSs and their associated parameters such as cognitive, perceptual, linguistic, and environmental demands
- Client appropriateness for ACS use (e.g., individual differences)
- Factors involved in training for ACS use, such as ease of symbol learning/iconicity, initial lexicon choice, training specific prerequisites vs. circumventing them, and the issue of what effect any of these factors may have on facilitating language development

We have also suggested that the major work of coordination of issues for assessment and training persons with severe handicaps and/or deaf-blindness remains to be done. Due to the severity of their deficits, the majority of children with deaf-blindness function in the prelinguistic level of language development. The major thrust of the research in implementing ACSs with this group, then, should be focused on approaches to facilitating early linguistic development and early ACS use.

The University of Wisconsin-Madison consortium site is directing research efforts in this area. During 1985 to 1987, our investigation addressed the issue of training early communication skills of children with severe handicaps and deaf-blindness who live in a residential facility. This inquiry, based on the social interaction hypothesis of language development, has addressed the following questions:

- Will specific training lead to increased responsiveness to the child on the part of caregivers?
- Will increased caregiver input lead to an increase in the child's social responsiveness during face-to-face interaction?
- Does increased caregiver input have a facilitative effect on the child's cognitive, prelinguistic, and adaptive skill development?

As part of this study, specific codes have been developed for coding caregiver and child responses during face-to-face interaction. Results of this research will lead to a greater understanding of the role of social interaction and its impact in communicative development of deaf-blind children.

We are also conducting research to examine the use of augmentative communication technology for training early communication behaviors. This research is based on the hypothesis (Reichle & Karlan, 1985) that early augmentative communication training may help foster cognitive and communicative development. In this project we are addressing two questions:

1. When given the choice of touching maximally distinguishable tactile surfaces on an augmentative device, will a severely/profoundly, developmentally delayed child with deaf-blindness demonstrate a preference for a tactile surface?
2. When the child's touch of a switch covered with the preferred surface is paired with social stimulation (tactual stimulation) from the caregiver, will the child increase activation of the switch, demonstrating an "intentional request for a preferred activity?"

Young children with severe cognitive and sensory impairments must overcome great barriers to acquire functional communicative skills. These children present an enormous challenge to professionals in special education and communicative disorders to develop effective techniques and strategies for communication training. Although in its infancy, the field of augmentative communication and the related areas of computer-aided instruction and contingency intervention have demonstrated the efficacy of these approaches in language/communication training of persons who have severe cognitive impairments (Behrmann & Lahm, 1984; Sternberg, Battle, & Hill, 1980; Sternberg & Owens, 1985; Sternberg, Battle, & Hill, 1983). Such results suggest that training with augmentative communication aids, techniques, and strategies may also benefit young children with deaf/blindness. It is anticipated that the research we are conducting will be an important step in exploring this issue.

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Appendix X-A: Communication systems used by persons who are deaf-blind (Adapted from Jensema, 1979a, 1979b, 1980, 1981; Musselwhite & St. Louis, 1982; Nelipovich & Naegele, 1985).

SYSTEM	DESCRIPTION
Speech	Among other things, speech production and perception involve the language user's ability to associate sounds with meanings. Moreover, language is generative, representing arbitrary connections among phonological, syntactic, and semantic systems.
Tadoma Method	This technique is a tactile means of decoding oral communication. The individual places his or her hand on the speaker's face with the thumb covering the mouth in order to feel lip, jaw, and tongue movements. The other fingers are spread over the cheek, jaw, and throat to detect vibrations.
Gestures/ Emotions	Gestures involve gross motor movements that can express emotions. Gestures are generally nonlinguistic, concept oriented, action oriented, reality oriented, and telegraphic. Gestures may also include <u>demonstrative</u> gestures (e.g., pointing), <u>descriptive</u> gestures (e.g., outlining three-dimensional representations of the object), or <u>symbolic</u> gestures.
Sign Systems	The most commonly used signing system among the deaf community in the United States is American Sign Language (ASL). It is a language in and of itself, with a unique syntactic structure. "Educational" sign systems (e.g., Signed English, American Manual Alphabet, Linguistics of Visual English, Signing Exact English) have a corpus of ASL signs, but approximate spoken English in syntax and morphology.
Fingerspelling	Fingerspelling is a tactual mode of communication, using 26 distinct handshapes to represent the letters of the Roman alphabet. Information is transmitted by placing the hand of the recipient over that of the communicator.
Total Communication	Total Communication uses a combination of sign and gestures simultaneously with spoken communication.
Morse Code	Morse Code uses a standard code of dots and dashes, which represent letters and numbers. The dots and dashes can be signalled gesturally (e.g., hand/finger taps, eye blinks). Messages can be transmitted via tactual input on any part of the body, either tactually or with an electronic device, which sequentially transmits the information.
Braille Hand Speech	Braille Hand Speech uses the initial, middle, and ring fingers of both hands of the receiver, inputting Braille code on a smooth surface of the receiver's body.

Cross Code	Cross code is based upon tactual input to the individual. The communicator taps the back of the hand or other designated place on the body with certain positions referring to certain letters. The message receiver must then interpret the meaning of the "spelled" words.
Palm Writing	The communicator uses an index finger to draw the letters of the alphabet in the palm of the person who is deaf-blind in order to spell out the messages.
Glove Method	The Glove Method requires the receiver to wear a glove containing alphanumeric characters. The message sender touches the letters or numbers in order to convey the message.
Pictures	Black and white or color pictures or photographs can be either abstract or highly representative of their referents. Pictures may provide an intermediate step between real life objects, events, and people, and more abstract and formal communication systems.
Standard Type or Print	Handwritten or typed messages in traditional orthography can be placed on paper or a communication board.
Large Type or Print	Written orthography or typed communication can be enlarged to sizes which can be viewed within the visual field.
Braille	Braille is a system of communication based on variations of raised dots among two vertical columns of three dots each. It is primarily used as a means for reading. It can also be used in communication by using preconstructed messages or an electronic device which can transpose, in real time, typewritten orthography into Braille text (e.g., TeleBraille).
Symbol Systems	Symbol systems (e.g., Blissymbols, Rebuses, Piesysms, Picture Communication Symbols, etc.) represent objects, people and events by varying levels of abstractions. Some symbol systems have been incorporated into actual grammatical codes.
Communication Boards	Any device composed of displays of pictures, words, objects, or other symbol systems which provide the person who is deaf-blind an opportunity to relate information.
Electronic Communication Boards	Electronic communication boards are composed of a symbol system display, a mechanism for the user to access the symbol system, and an electronic system to transfer/translate the message via an auditory or visual output mode.
Telephone Communication Systems	TDD's or TTY's convert typed input to an audio frequency, which is then converted back to its corresponding letter through an acoustically coupled telephone. The TeleBraille can convert the audio frequency to Braille output, as well as accept Braille input.

Appendix X-B: Communication aids for use by persons with deaf-blindness. (Adapted in part from Brandenburg, Bengston, & Vanderheiden (1986); Enders (1985); Jensema (1979a, 1979b, 1980, 1981); Musselwhite & St. Louis, (1982); Nelipovich & Naegele (1985).

a. Overview

AID NAME (Key to Manufacturer)	DESCRIPTION	USE	MODIFICATIONS SUGGESTED FOR THOSE WHO ARE SENSORY IMPAIRED
Activity Board (4)	A 5-pound portable activity center consisting of 21 three-inch squares, which may be combined to form larger message areas. It may be used to operate toys or environmental controls by direct selection.	Training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects)
AllTalk (5)	A portable communication and training aid, which comes in two sizes: 16" x 20" x 2" or 10" x 15" x 2". AllTalk is a human voice output communicator and training aid. It uses a membrane keyboard, which may be programmed with between 1 to 128 areas for words or messages. AllTalk can be easily programmed by teachers or parents. All words, phrases, or sounds may be changed at any time, and may be stored on any standard cassette player for access at a later time. Words are accessed through direct selection.	Communication and training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects)
Alternative Keyboards (6-14)	Designed to provide computer access for persons who cannot operate a standard computer keyboard in an effective manner. Examples include the Compuadapter, Expanded Keyboard for the Apple, Keyport 717, King Keyboard, Koala Pad Touch Tablet, the MOD Keyboard, TETRAscan II, and the Unicorn	Communication and training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects)

1. The display area of each of the keys can be modified to provide larger or smaller "keys" for the user.

Express 3 [no longer available]	(15) A 9.5 pound portable micro-processor-based communication aid, which provides written or synthetic speech output. Selections may be made directly with an optical head pointer or through row/column scanning. Contains a total of 99 programmable levels, each accepting up to 800 characters of words or phrases. Also has a keyboard interface allowing access to standard computers.	Communication and training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects)
Optacon	(16) A portable 4-pound aid for those who are blind. A 6 X 20 array of pins transmits vibrotactile stimulation to the users' finger tip. Requires movement of the Optacon camera (about the same size as a pack of gum) to specific areas of document (including books, or computer screen).	Reading books, maps, or any information provided on paper	None
TDDs or TTYs (17-28)	Can be interfaced with other electronic devices (e.g., Versa Braille) to allow the user to converse over the telephone. Output may be printed, stored in memory, or translated into Braille, if the TDD is used with another Braille device. The user also has the option of varying the rate at which the transmission (BAUD) of information occurs.	Communication (writing) over the telephone	None
Touch Talker	(30) A 5.25 portable communicator (13" x 8.8" x 2.75") is accessed by direct selection on its 8 X 16 keyboard. Messages can be composed on the LCD before being spoken. Vocabulary is	Communication and training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens,

	user definable. Selections are easily viewed on an LCD display. Options include Minspeak, Express software, and an RS-232C serial port which can be used to provide access to a computer. Touch Talker may also be used as a stationary printer or environmental control aid.		and/or miniature objects)
Versa Braille (30)	A 10-pound portable word processor, computer terminal, read/write notetaker, and printer driver. It interfaces with IBM PC, Apple, Radio Shack, and Mainframe computers and provides a 20-character electromechanical Braille pin output. It can also print in Braille, or produce audio output.	Writing or reading of computer documents	None
Wolf (31)	A 2-pound portable voice output communication aid, which uses the Texas Instruments "Touch and Tell" touch panel. The touch panel is made of a 6 x 6 matrix of 1.25-inch squares, which may also be grouped together for larger message areas. Each area may be programmed with up to 128 characters per area. Vocabulary choices are made by direct selection, and may reside in a memory buffer for any period of time.	Communication and training	Use of tactually distinguishable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects)
Symbol Training Display (32)	Designed to teach individuals object-to-picture association. Cards or objects are placed in clear plastic bags which snap to the Symbol Training Display in four quadrants. Lights in each quadrant can be activated by the trainer to reinforce correct responses, or provide correction of inaccurate responses. A switch is mounted in back of the unit so that the trainer can provide additional reinforcement by	Training	Could be modified to teach a deaf blind child to associate objects and tactually distinguishable symbols (e.g., Braille, Premack Tokens, and/or miniature objects)

activating a tape recorder or battery-operated toy.

SpeechPad (33)	An adapted PowerPad that allows its use for synthesized speech output without being connected to a computer. The 12" x 12" surface is divided into 3" x 3" blocks. There are 15 distinct levels among which the user may move. Each block may be programmed to store a word or phrase of up to 40 characters on each of the 15 levels. Pressing a combination of two blocks activates the built-in speech synthesizer. User-selectable symbols are placed on the surface. Vocabulary may be programmed directly, or by using an Apple II+ and a Votrax Type 'N Talk, then downloading it to the Speech Pad.	Communication and training	Use of tactually discriminable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects) approximately 1/2 inch in size
VOIS 135 (34)	A voice output (synthesized speech) communication device with 118 selection locations on four programmable levels. The user may program messages or words for each location, or locations may be grouped for larger selection areas. Any symbols or words is user defined. Programming the spoken messages using phonemes to ensure proper pronunciation of intended words or messages is recommended. A keyguard is also available.	Communication and training	Use of tactually discriminable symbol sets (e.g., Braille, Premack Tokens, and/or miniature objects) approximately 1/2 inch in size
VOIS 140 (34)	The Vois 140 is a three-digit encoding communication aid with speech output. The user enters a three-digit number on the keyboard, and each number combination is assigned a word, phoneme, morpheme, letter, or phrase. 891 words, 45 phonemes, 13 morphemes, 26 letters, and 19 phrases are	Communication and training	Replaces the numbers and six operational keys with raised numbers or Braille to permit tactual discrimination

preprogrammed. Messages may be constructed and stored in the Vois 140's 3,000-keystroke memory and spoken as a group, or each word or phrase may be spoken as it is encoded. The Vois 140 includes a keyguard. Use of phonemes in message composition allows for unlimited vocabulary by phonemically spelling the words or messages. Volume is user adjustable.

1. Most of the devices described in this appendix were not designed specifically for use by persons with deaf-blindness. The modifications suggested within have not been examined empirically and reflect the views of communication training discussed in this chapter. In attempting to use these or any other modifications or devices with persons with deaf-blindness, clinicians should consider the child's cognitive level, motor ability, and needs for portability, in addition to their sensory impairments.

b. Manufacturer's address listing

Reference Number	Aid Name	Vendor/Address
1.	Votrax Type-N-Talk	Votrax Consumers Products 500 Stephenson Highway Troy, MI 48084 (800) 521-1350
2.	Echo II	Street Electronics 1140 Mark Avenue Carpinteria, CA 93103 (805) 684-4593
3.	DecTalk	Digital Equipment Corp. 146 Main St. Maynard, MA 01754 (800) DIGITAL
4.	Activity Board	Contemporary Artistic Technology Co. Ltd. P.O. Box 58430, Station L Vancouver, BC V6P 6K2 Canada (604) 324-8119
5.	AllTalk	Adaptive Communication Systems, Inc. 994 Brakhead Road, Suite 202 Coraopolis, PA 15108 (412) 264-2288
6.	Computapeter	Martin Gale R/M Systems 22903 Farm Avenue Torrance, CA 90505 (213) 534-1880
7.	Expanded Keyboard for the Apple	EKEG Electronics Co. LTD. P.O. Box 46199 Vancouver, BC V64 4G5 Canada (604) 685-7817
8.	Koala Pad	Koala Technologies Corp. 3100 Patrick Henry Drive Santa Clara, CA 95050 (408) 986-8866
9.	Keyport 717	Instructional Computing Services P.O. Box 10998-477 Austin, TX 78766 (512) 250-8601

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| 10. | King Keyboard | FASH, Inc.
70 Gibson Dr.
Markham, ON L3R 2Z3
Canada
(416) 475-2212 |
| 11. | MOD Keyboard
System | FASH, Inc.
70 Gibson Drive
Markham, ON L3R 2Z3
Canada
(416) 475-2212 |
| 12. | PowerPad | Ben Satterfield
Chalk Board, Inc.
3772 Pleasantdale Rd.
Atlanta, GA 30340
(800) 241-3989 |
| 13. | TETRAscan II | Zygo Industries, Inc.
P.O. Box 1008
Portland, OR 97207
(503) 297-1724 |
| 14. | Unicorn
Expanded
Keyboard | Unicorn Engineering Co.
6201 Harwood Ave.
Oakland, CA 94618
(415) 428-1626 |
| 15. | Express 3 | Prentke Romich Company
1022 Heyl Rd.
Wooster, OH 44691
(216) 262-1984 |
| 16. | Optacon | Telesensory Systems Inc.
455 North Bernardo Avenue
P.O. Box 7455
Mountain View, CA 94943 |
| 17. | Am-Com I | American Communication Systems, Inc.
994 Broadhead Road, Suite 202
Coraopolis, PA 15108
(412) 264-2288 |
| 18. | Echo 2,000 | Palmetto Technologies, Inc.
P.O. Box 498
Duncan, SC 29334
(803) 439-4309 |
| 19. | Intele-Type | Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719
(608) 273-0707 |

- | | | |
|-----|-----------------------------|---|
| 20. | LUV I | American Communication Corporation
180 Roberts Street
East Hartford, CT 06108
(203) 289-3491 |
| 21. | Minicom II | Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719
(608) 273-0707 |
| 22. | Miniprint | Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719
(608) 273-0707 |
| 23. | Porta Printer
Plus/Model | Krown Research, Inc.
6300 Arizona Circle
Los Angeles, CA 94005
(213) 641-4306 |
| 24. | SSI-100
Communicator | Specialized Systems, Inc.
6060 Corte del Dedro
Carlsbad, CA 92008
(619) 438-8800 |
| 25. | SSI-200
Communicator | Specialized Systems, Inc.
6060 Corte del Dedro
Carlsbad, CA 92008
(619) 438-8800 |
| 26. | SSI-240
Communicator | Specialized Systems, Inc.
6060 Corte del Dedro
Carlsbad, CA 92008
(619) 438-8800 |
| 27. | Superphone B/X | Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719
(608) 273-0707 |
| 28. | Trendcom | 3M Company
Business Communication Products
3M Center
St. Paul, MN 55144
(612) 733-5454 |
| 29. | Touch Talker | Prentke Romich Company
1022 Heyl Rd.
Wooster, OH 44691
(216) 262-1984 |
| 30. | Versa Braille | Telesensory Systems Inc.
455 North Bernardo Avenue
P.O. Box 7455
Mountain View, CA 94943 |

31. Wolf Wayne County Intermediate School District
 Attn: Greg Turner
 33500 Van Born Road
 P.O. Box 807
 Wayne, MI 48184
 (313) 467-1415
32. Symbol Don Johnson Developmental Equipment
 Training 981 Winnetka Terrace
 Lake Zurich, IL 60047
 (312) 438-3476
33. Speechpad Crabapple Systems, Inc.
 126 Commercial St.
 Portland, ME 04101
 (207) 772-8610
34. VOIS 135 Phonic Ear, Inc.
 VOIS 140 250 Camino Alto
 Mill Valley, CA 94941
 (415) 383-4000